

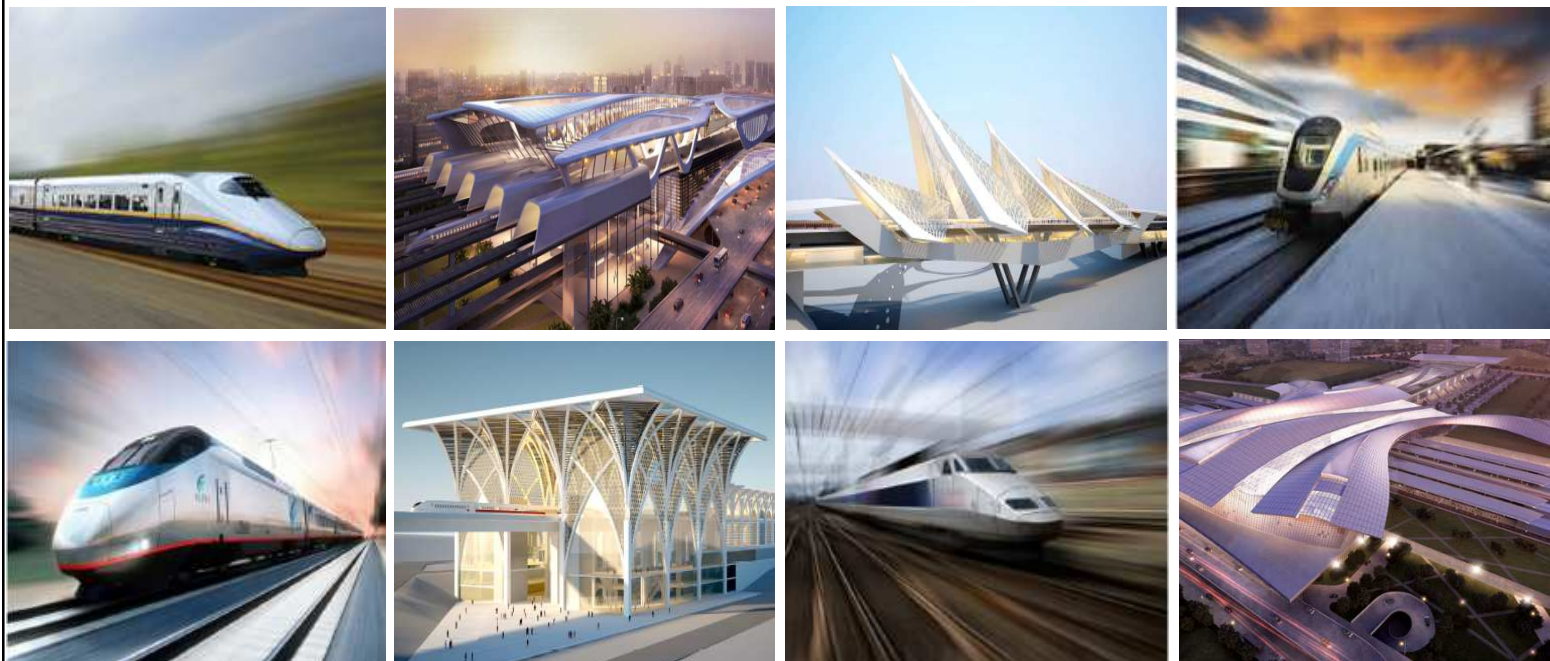


MYHSR CORPORATION SDN BHD

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

KUALA LUMPUR - SINGAPORE HIGH SPEED RAIL (HSR) PROJECT

VOLUME 2b: MAIN TEXT CHAPTERS 7 TO 10



FEBRUARY 2018

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LIST OF ABBREVIATION

| | |
|-----------------|--|
| 11MP | Eleventh Malaysia Plan |
| AHP | Analytical Hierarchy Process |
| ARI | Average Recurrence Interval |
| BOD | Biochemical Oxygen Demand |
| BP | Bored Piling |
| CBD | Central Business Districts |
| CF | Carbon Footprint |
| CFSR | Climate Forecast System Reanalysis |
| CGSO | Chief Government Security Office |
| CHSR | Conventional High Speed Rail |
| CIQ | Customs, Immigration and Quarantine |
| CO ₂ | Carbon Dioxide |
| COD | Chemical Oxygen Demand |
| CSO | Customer Service Office |
| DGPS | Differential Global Positioning System |
| DID | Department of Irrigation and Drainage |
| DOE | Department of Environment |
| EIA | Environmental Impact Assessment |
| E-P | Employment-population |
| EPB | Earth Pressure Balance |
| EPP | Entry Point Projects |
| ERL | Express Rail Link |
| ESA | Environmental Sensitive Areas |
| ESI | Environmental Scoping Information |
| ETP | Economic Transformation Programme |
| FHTS | Futuristic Hyperloop Train System |
| FT | Federal Territory |
| GAQM | Guideline on Air Quality Models |
| GBI | Green Building Index |
| GDP | Gross Domestic Product |
| GEV | General Extreme Value |
| GHG | Green House Gasses |
| GIS | Geographic Information System |
| GNI | Gross National Income |
| Greater KL / KV | Greater Kuala Lumpur / Klang Valley |
| HIA | Heritage Impact Assessment |
| HMB | Heavy Maintenance Base |
| HPU | Highway Planning Unit |
| HSR | High Speed Rail |
| IKBN | Institut Kemahiran Belia Negara |
| INFRA | Institut Kemajuan Desa |
| INSPEN | Institut Penilaian Negara |

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| IRDA | Iskandar Regional Development Authority |
| ITCZ | Intertropical Convergence Zone |
| ITD | Integrated Transport District |
| JBIA | Johor Bahru International Airport |
| JKR | Public Works Department |
| JMG | Department of Mineral and Geoscience Malaysia |
| JUPEM | Department of Survey and Mapping Malaysia |
| Kg. | Kampung |
| KKM | Kementerian Kesihatan Malaysia, Ministry of Health |
| KTM | Keretapi Tanah Melayu |
| LIDAR | Light Detection and Ranging |
| LMB | Light Maintenance Base |
| LOS | Level of service |
| LTA | Land Transport Authority |
| MAAQG | Malaysian Ambient Air Quality Guidelines |
| MHST | Maglev High Speed Train System |
| MSJCE | Malaysian-Singapore Joint Committee on the Environment |
| MSL | Mean Sea Level |
| MVV | Malaysia Vision Valley secretariat |
| MY - SG | Malaysia - Singapore |
| MyHSR Corp | MyHSR Corporation Sdn Bhd |
| NATM | New Austrian Tunneling Method |
| NKEA | National Key Economic Area |
| NSE | North-South Expressway |
| NTU | Nephelometric Turbidity Unit |
| NWQS | National Water Quality Standard |
| OCS | Overhead Catenary System |
| OHLE | Overhead Line Electrification |
| ORR | Office of Rail and Road |
| PDP | Project Delivery Partner |
| PE | Population Equivalent |
| PERHILITAN | Department of Wildlife and National Parks Peninsular Malaysia |
| PERKESO | Pertubuhan Keselamatan Sosial Malaysia |
| PLANMalaysia | Federal Department of Town and Country Planning |
| PM | Particulate Matter |
| PM10 | Particulate Matter 10 micrometers or less in diameter |
| PM2.5 | Particulate Matter 2.5 micrometers or less in diameter |
| PPV | Peak Particle Velocity |
| PVS | Peak Vector Sum |
| R&D | Research and Development |
| RDC | Reference Design Consultants |
| ROW | Right Of Way (30 m to 100 m) |
| RPZ | Railway Protection Zone |
| SDF | Strategic Development Framework |
| SEL | Sound Exposure Level |

CHAPTER 7

EVALUATION OF IMPACTS

7.1 INTRODUCTION

In this Chapter, impacts which Project activities could induce on adjacent environmental resources and receptors, during its pre-construction, construction and operational phase, are elucidated. The impact assessment that has been conducted has relied on the nature and scope of Project activities as described in Chapter 5, as well as on the information presented in Chapter 6 on the current status of environmental receptors and resources that have been signaled out as having the potential to be impacted upon by the HSR Project.

The scope, intensity and temporal and spatial characteristics of each impact are elaborated in this Chapter. Mitigation measures which are recommended to be adopted, in addition to those already inculcated in preliminary designs, so as to reduce adverse impacts to tolerable levels are described in **Chapter 8**. The assessment matrix for the Project can be found at the end of this chapter.

7.2 AIR QUALITY IMPACTS

7.2.1 Construction Phase

Air pollution is a significant environmental perturbation that will occur during the construction phase of the HSR Project. Suspended Particulate Matter (SPM) is expected to be generated during site preparation activities and during earthworks operations; especially during clearing of project areas when ground areas are laid bare. Earthwork operations will churn up soil layers and thereby exacerbate tendencies for particles to become airborne as dust particles. Stockpiles of topsoil, uncovered loads on construction vehicles and unprotected cleared areas are other potential SPM sources. In addition, SPM could be generated during unsealed road use by construction traffic. SPM emissions often vary substantially from day to day, depending on the level of activity, the specific operations, and prevailing meteorological conditions.

For this study the SPM parameter which will be employed to predict dust impacts on the environment is **PM₁₀**; i.e. particulate matter less than 10 microns. The reasons being that firstly this parameter is the one of only two SPM components assigned a baseline ambient regulatory standard under the **Year 2013 Malaysian Ambient Air Quality Guidelines**

CHAPTER 7: EVALUATION OF IMPACTS

(**MAAQG**); the other parameter being **PM_{2.5}**. These two particle sizes are capable of being drawn into a person's lungs and thereby induce health hazards. The parameter **PM_{2.5}** is not considered in this study as its presence in dusts associated with earthworks is minute.

The **MAAQG (Table 7-1)** will be employed in this study as a reference standard to assess the intensity of dust impacts imposed on environmental receptors.

Table 7-1: Year 2013 Malaysian Ambient Air Quality Guidelines (at 273 K and 101.13kPa)

| Pollutant | Average Time | Unit | IT-1 (2015) | IT-2 (2018) | Standard (2020) |
|-------------------|-------------------|-------------------|-------------|-------------|-----------------|
| PM ₁₀ | 24-hour Annual | µg/m ³ | 150 50 | 120 45 | 100 40 |
| PM _{2.5} | 24-hour Annual | µg/m ³ | 75 35 | 50 25 | 35 15 |
| Sulphur dioxide | 1-hour 24-hour | µg/m ³ | 350 105 | 300 90 | 250 80 |
| Nitrogen dioxide | 1-hour 24-hour | µg/m ³ | 320 75 | 300 75 | 280 70 |
| Carbon monoxide | 1-hour 8-hour | µg/m ³ | 35 10 | 35 10 | 30 10 |
| Ozone | 1-hour 8-hour | µg/m ³ | 200 120 | 200 120 | 180 100 |

IT: Interim target

For this EIA study, predictions of **PM₁₀** dispersions and their impact on environmental receptors will be addressed in relation to the construction of three types of Project facilities, they being (a) Buildings (Stations, Depots and Maintenance Bases); (b) the HSR alignment; and (c) Construction access roads.

Construction activities consist of a series of different operations, each with its own duration and potential for dust generation. In other words, emissions from any single construction site can be expected (i) to have a definable beginning and an end and (ii) to vary substantially over different phases of the construction process. This is in contrast to most other fugitive suspended **PM₁₀** sources, where emissions are either relatively steady or follow a discernable annual cycle. Furthermore, there is often a need to estimate area wide construction emissions, without regard to the actual plans of any individual construction project. For these reasons it is very difficult to estimate the potential **PM₁₀** emissions from the

sources. However, it can be said that the quantity of PM₁₀ emissions from construction operations are (i) proportional to the area of land being worked and to the level of construction activity, (ii) positively correlated with the silt content of the soil, (iii) dependant on the speed and weight of the average vehicle and (iv) negatively correlated with the soil moisture content. A more significant potential cause of increased PM₁₀ levels during construction will be inappropriate disposal of vegetation during site clearance and preparation.

Based on these limitations and a set of field studies which attempts to relate the emissions from construction directly to an emission factor, the approximate emission factor for construction activity operations is (USEPA, 1995):

$$E = 2.69 \text{ megagrams (Mg)/hectare/month of activity}$$

This value is most useful for developing estimates of overall emissions from construction activity scattered throughout a geographical area. The value is most applicable to construction operations with: (i) medium activity level, (ii) moderate silt contents, and (iii) semi-arid climate which is applicable in this assessment study.

7.2.1.1 Particulate Matter PM₁₀ Emission Rates

The HSR Project is to be developed over four (4) states and two (2) federal territories. For purposes of assessing air quality impacts, the Project Area is divided into four (4) sectors, namely (i) FT. Kuala Lumpur/ FT. Putrajaya / Selangor, (ii) Negeri Sembilan, (iii) Melaka and (iv) Johor. The amount of PM₁₀ emitted for each construction activity at each location is computed based on the size of the construction area and the duration of the construction activity using the above formula, $E = 2.69$ megagrams (Mg)/hectare/month of activity. As the construction area for each facility is different, the following are the emission rates of PM₁₀ for each facility.

i) Sepang-Putrajaya, Seremban, Melaka, Muar and Batu Pahat Stations

Site areas demarcated for the Sepang-Putrajaya, Seremban, Melaka, Muar and Batu Pahat Stations are all similar in size i.e. 13 ha. Expected construction period for the stations is 36 months. The gross amount of particulate emission per station site is estimated to be **1,258.92 Mg** ($2.69 \times 13 \times 36$). The corresponding temporal emission rates are (a) **34.97 Mg/month** ($1,258.92 / 36$); (b) **1,166 kg/day** (assuming there are 30 days in a month); and 97.1 kg/hr ($1,166 / 12$) or **26.98 g/s** assuming that construction activities are conducted only during a period of 12 hours a day. The estimated PM₁₀ uncontrolled emission rate of **26.98 g/s** is derived from USEPA's assumption that fifty percent of construction related suspended particulate matter is made of PM₁₀ particles (page 13.2.5-14, A.P. -42, USEPA 1995). However, in the case when there are control measures such as keeping exposed surfaces moist, covered and paved, the emission rate can be reduced by as much as 98 to 99 percent. For modeling purposes, the PM₁₀ emission rate was assumed to be reduced by 98 percent; as such the emission rate employed in the modeling is 0.27 g/s for the **with control measure scenario**.

ii) Bandar Malaysia and Iskandar Puteri Station

The Bandar Malaysia and Iskandar Puteri Station are each 26 ha in area; with an expected construction period of 36 months.

The gross amount of particulate emission per station site is estimated to be **2517.84 Mg** ($2.69 \times 26 \times 36$). The corresponding temporal emission rates are (a) **69.94 Mg/month** ($2517.84/36$); (b) **2331 kg/day** (assuming there are 30 days in a month); and **194 kg/hr** ($2,331 / 12$) or **54.9 g/s** assuming that construction activities are conducted only during a period of 12 hours a day. The estimated PM₁₀ uncontrolled emission rate of **54.9 g/s** is derived from USEPA's assumption that fifty percent of construction related suspended particulate matter is made of PM₁₀ particles (page 13.2.5-14, A.P. -42, USEPA 1995). However, in the case when there are control measures such as keeping exposed surfaces moist, covered and paved, the emission rate can be reduced by as much as 98 to 99 percent. For modeling purposes, the PM₁₀ emission rate was assumed to be reduced by 98 percent; as such the emission rate employed in the modeling is 0.55 g/s for the **with control measure scenario**.

iii) Light Depot and Light Maintenance Base, Serdang

The Light Depot and Light Maintenance Base (LMB) is located in Serdang, Selangor covering an area of 70 ha. By the same method of calculations as above, the PM_{10} emission rate when there are dust control measures taken is estimated at **1.48 g/s**; and for the without control measures case, the emission rate is predicted to be **74.03 g/s**.

(iv) Heavy Maintenance Base, Muar

For the Heavy Maintenance Base (HMB) located in Muar, covering an area of 10 ha, the PM_{10} emission rate when there are dust control measures in place is predicted to be **0.21 g/s**; and for the case without control measures, the PM_{10} emission rate is predicted to be **10.6 g/s**.

(v) Main Depot and Light Maintenance Base, Pontian

The size of the Main Depot and Light Maintenance Base, Pontian is 110 ha. The PM_{10} emissions from the construction of this facility are expected to be large and significant. The PM_{10} emission rate is predicted to be **2.32 g/s** for the with control measure scenario, and **116.3 g/s** for the without control measures scenario.

(vi) HSR Alignment

Construction of the HSR alignment will entail the construction of columns, bridges, tunnels and other structures including the alignment itself. For construction of the alignment, the width of the alignment is taken as 50 m and construction area of 2 ha. With this area, the PM_{10} emission rate is **0.042 g/s** for the with control scenario and **2.07 g/s** for the without control measures scenario.

7.2.1.2 Impact Assessment

The air quality impact assessment is conducted in accordance with USEPA Guideline on Air Quality Models (GAQM; as incorporated in Appendix W of 40 CFR Part 51). The guideline recommends a three (3) phase approach which is as follows;

Phase 1. Apply a simple screening procedure to determine if either (i) the source clearly poses no air quality problem or (ii) the potential for an air quality problem exists.

Phase 2. If the simplified screening results indicate a potential threat to air quality, further analysis is warranted, and the detailed screening (basic modelling) procedures should be applied.

Phase 3. If the detailed screening results or other factors indicate a problem, then a more refined analysis is necessary.

As this assessment involves fugitive emissions, a refined analysis was conducted. It should be noted that the USEPA promulgated a revision to the Guideline on Air Quality Models (GAQM) on November 9, 2005 and the revised version of GAQM adopts AERMOD as the preferred dispersion model.

Dispersion modeling for this EIA study was conducted employing the **USEPA's AERMOD model** (Version 15181, July 2015) together with one year of meteorological data generated by the Mesoscale Meteorological Model (MM5) for each Project sector. This one-year data set is processed with AERMET, the meteorological processor for AERMOD, in accordance with guidelines provided by USEPA in the recently revised AERMOD Implementation Guide (AIG; USEPA, March 19, 2009). Details of the AERMOD Model are presented in **Appendix 7A**.

Air quality impact assessments carried out for the HSR Project were spread over four (4) sectors, namely (i) the FT. Kuala Lumpur / FT. Putrajaya / Selangor sector, (ii) the Negeri Sembilan sector, (iii) the Melaka sector, and (iv) the Johor sector. Within each sector dust dispersions induced by the construction of stations, depots/maintenance bases and the HSR alignment itself were modeled.

A) FT. Kuala Lumpur / FT. Putrajaya / Selangor

Construction of the Bandar Malaysia Station, the Sepang-Putrajaya Station, the Light Depot and Light Maintenance Base (LMB), Serdang and the HSR alignment will take place within the FT. Kuala Lumpur / FT. Putrajaya / Selangor sector. Their construction activities could impact on the air quality status in the vicinity of these respective sites.

Bandar Malaysia Station

The maximum 24-hour average PM_{10} incremental concentrations predicted to be imposed on areas surrounding the Station site, arising from construction activities conducted within the Station site when there are dust control measures being implemented, is depicted in **Figure 7-1**. The affected areas are at the construction site itself and areas surrounding it. The increase in PM_{10} concentration varies between a low of $1 \mu g/m^3$ at distances of approximately 2 km away and $20 \mu g/m^3$ at the boundary of the project site, with the highest level of $30 \mu g/m^3$ occurring within project site. Even with the additional PM_{10} concentrations that are predicted to be imposed at the locality of Receptor A1 (existing monitored baseline PM_{10} concentration of $35 \mu g/m^3$), and at the existing Station site boundaries, the resulting absolute ambient air PM_{10} concentration will still be below the corresponding 24 hour PM_{10} Malaysian Ambient Air Quality Guideline (MAAQG) 2020 target standard of $100 \mu g/m^3$ at these areas. Similarly, elsewhere, the maximum 24-hour average PM_{10} concentration is also predicted to be below the MAAQG limit.

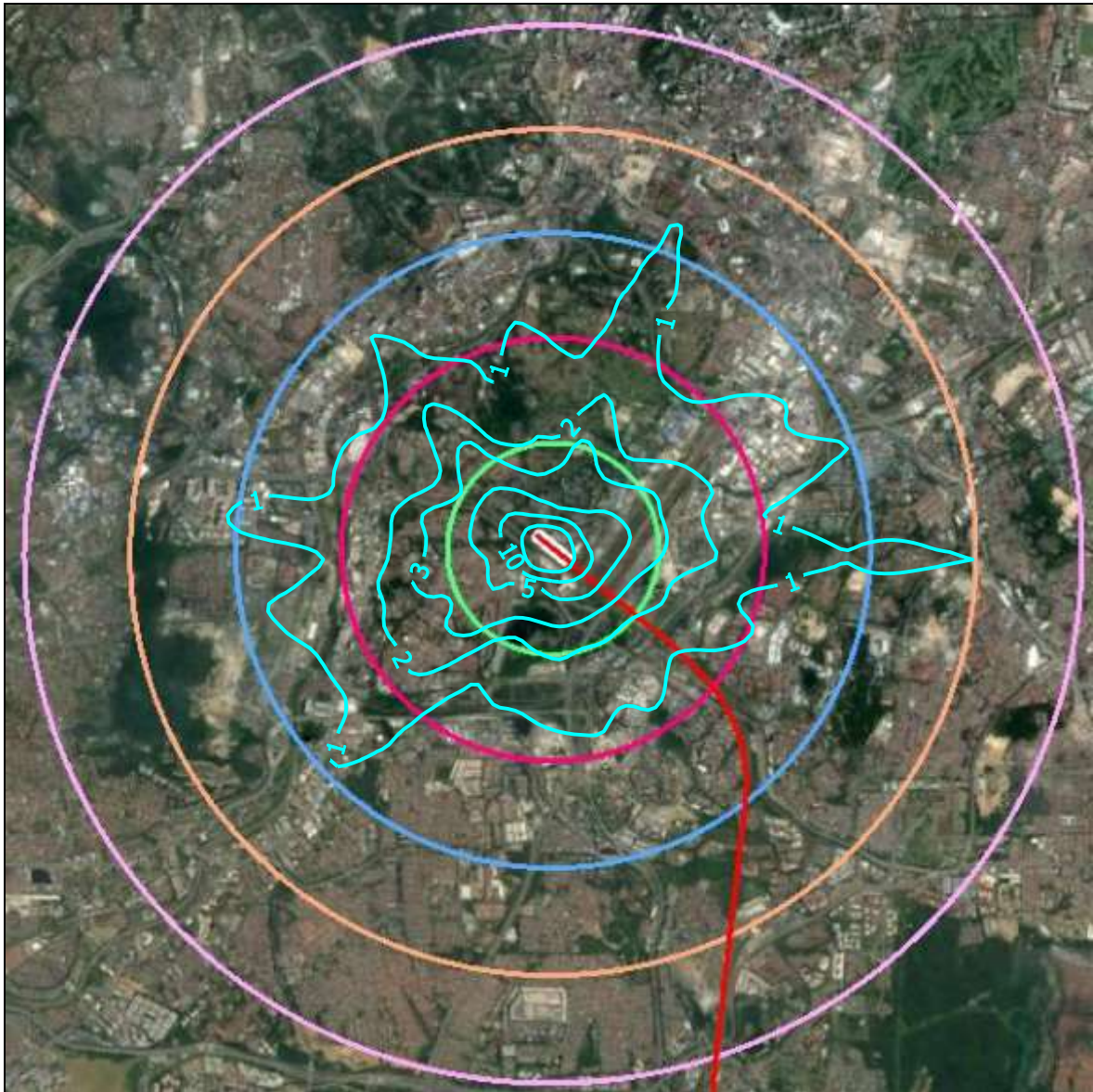


Figure 7-1: Maximum 24-hour Average PM₁₀ Incremental Concentration (µg/m³)
With Control Measures: Bandar Malaysia Station

On an annual average basis, the incremental PM₁₀ annual average concentration is predicted to be between 0.1 µg/m³ at 1.5 km away from the station site and approximately 1 µg/m³ at the project site boundary as shown in **Figure 7-2**. These incremental concentrations are insignificant and expected to be below the annual average MAAQG 2020 PM₁₀ target standard of 40 µg/m³.

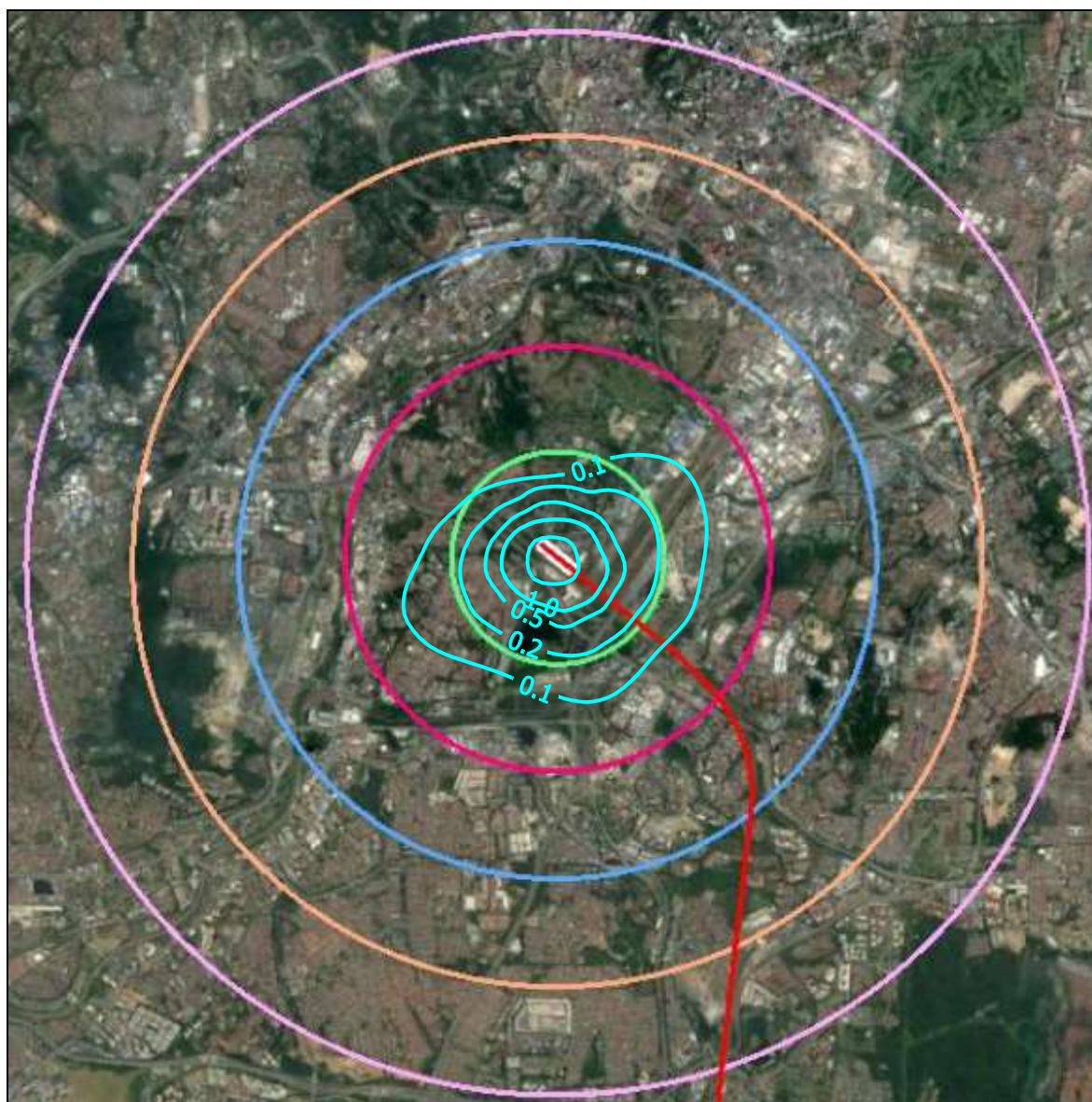


Figure 7-2: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Bandar Malaysia Station

In the event that there are no dust control measures being adopted to reduce dust emissions during the station's construction phase, the maximum 24-hour average PM₁₀ incremental concentrations that will be imposed at the edge of the receptor grid, at the project site boundary and within the project site are predicted to be of the order of 20 $\mu\text{g}/\text{m}^3$, more than 500 $\mu\text{g}/\text{m}^3$ and be about 1,000 $\mu\text{g}/\text{m}^3$ respectively. The contours of the predicted incremental concentration are shown in **Figure 7-3**. Based on an existing PM₁₀ baseline concentration of between 35 $\mu\text{g}/\text{m}^3$ and 41 $\mu\text{g}/\text{m}^3$ measured at Receptors A1 and A2 respectively, the resulting cumulative predicted ambient air PM₁₀ concentration will be well above the MAAQG

2020 target standard of $100 \mu\text{g}/\text{m}^3$ in areas around the project site as well as at receptors up to 2 km away.

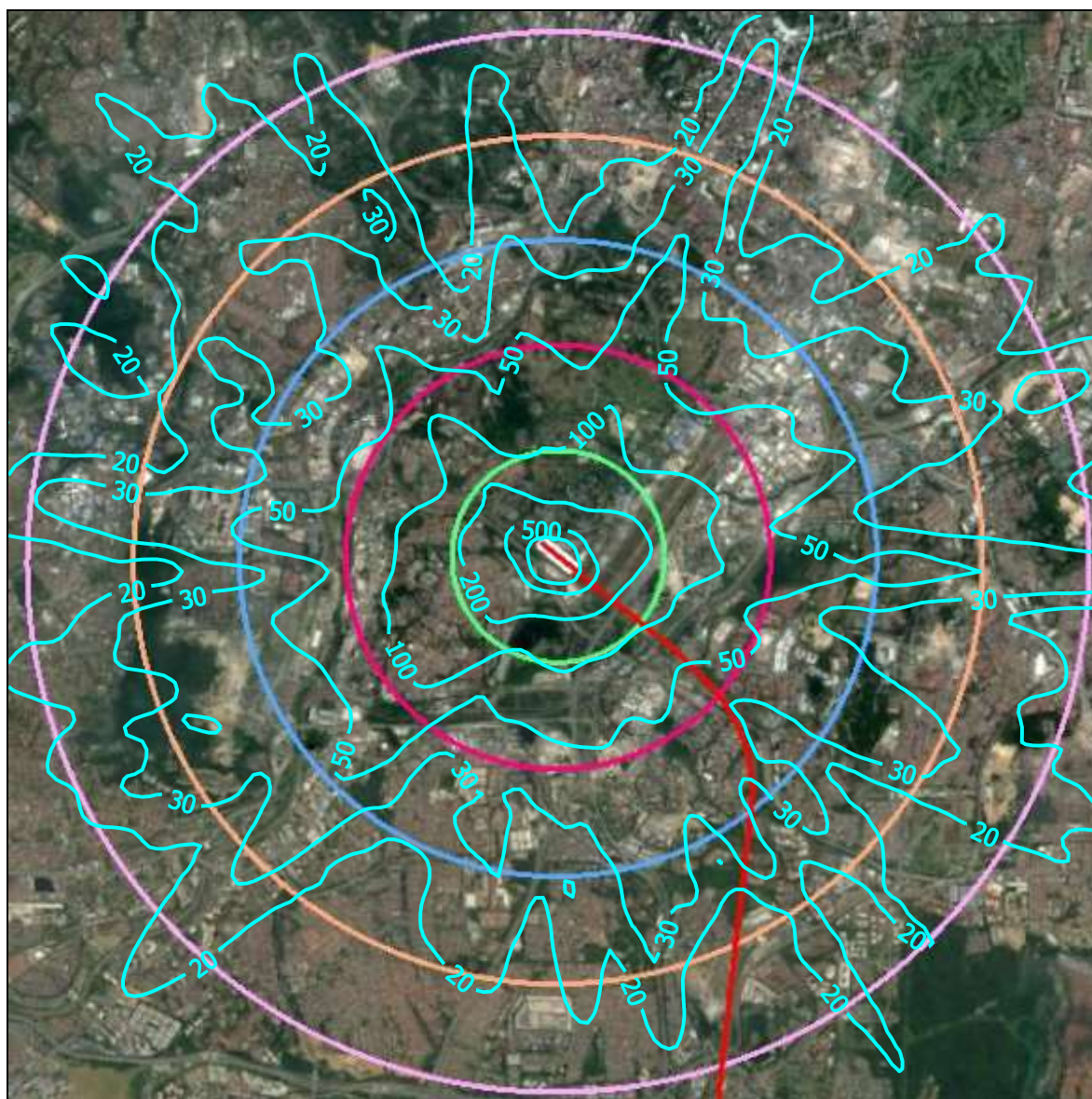


Figure 7-3: Maximum 24-hour Average PM_{10} Concentration ($\mu\text{g}/\text{m}^3$)
Without control measures: Bandar Malaysia Station

On an annual average basis, the incremental PM_{10} concentrations is predicted to be between $1 \mu\text{g}/\text{m}^3$ at 4 km away from the Station site and $100 \mu\text{g}/\text{m}^3$ at the project site boundary. These incremental concentrations are above the MAAQG 2020 target standard of $40 \mu\text{g}/\text{m}^3$ at receptors near the project site.

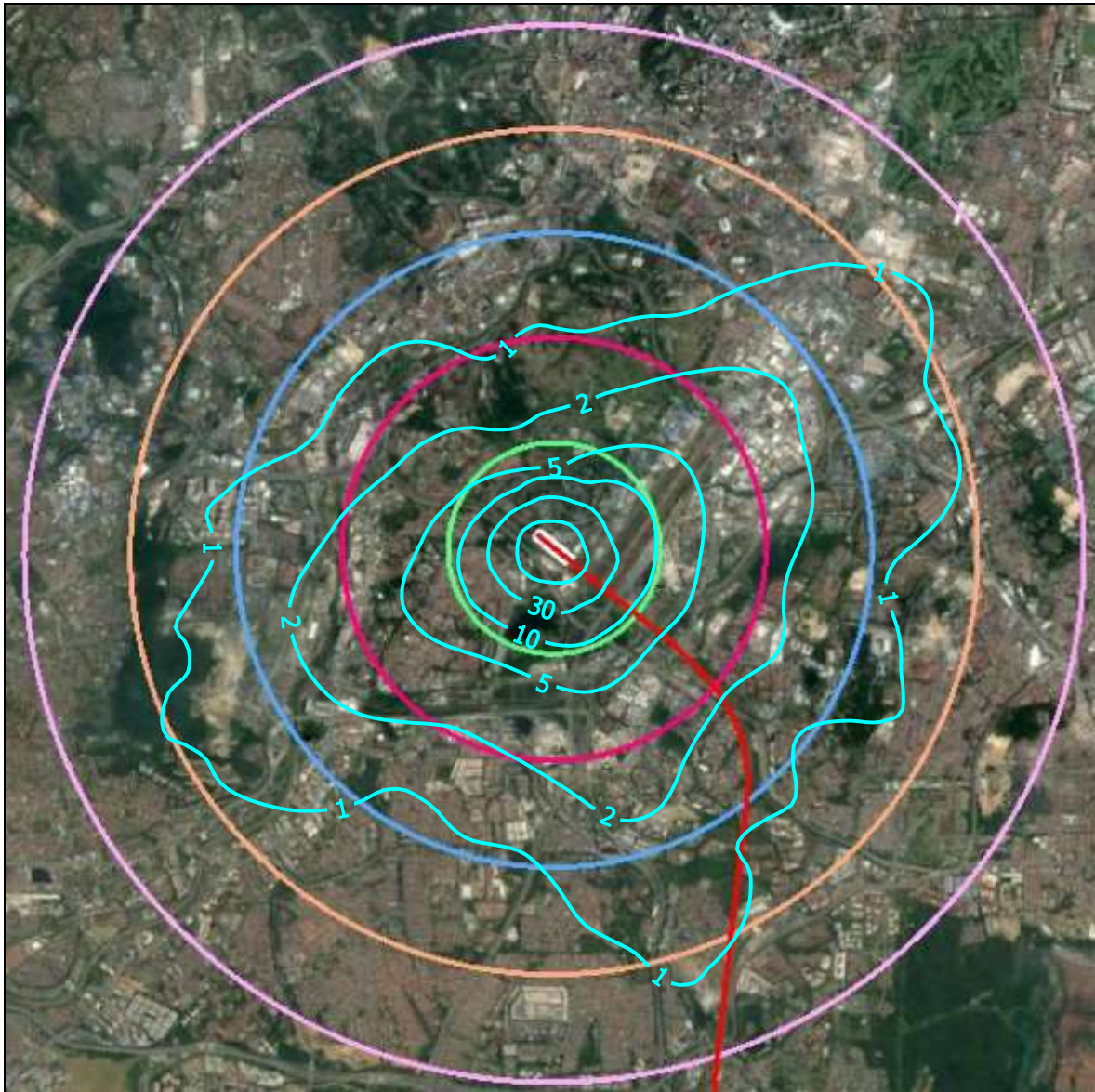


Figure 7-4: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
Without Control Measures: Bandar Malaysia Station

Predicted PM₁₀ incremental concentrations in $\mu\text{g}/\text{m}^3$ at the identified sensitive and discrete receptors located within 5 km radius of the Bandar Malaysia Station, for both the with control and without control measures scenarios, are tabulated below;

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i) With control measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|-----------------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Bandar Malaysia Station, A1 | 35 | 21.6 | 3.4 | 56.6 | - |
| Bandar Sri Permaisuri, A2 | 41 | 1.0 | 0.1 | 42.0 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

ii) Without control measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|-----------------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Bandar Malaysia Station, A1 | 35 | 1,079 | 172 | 1,104 | - |
| Bandar Sri Permaisuri, A2 | 41 | 48 | 3 | 89 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

Sepang-Putrajaya Station

Air quality impacts that could be induced by the construction of the Sepang-Putrajaya Station are similar in scope to that predicted for the Bandar Malaysia Station as discussed above. However the impacted areas are smaller in size, and predicted PM_{10} imposed concentrations are lower, as the size of the construction area is smaller. When there are no dust control measures being adopted at the construction site, areas which will exceed the MAAQG limits for PM_{10} concentrations will be located within approximately 1 km from the Project site. Contours of the predicted maximum 24-hour average and annual average PM_{10} incremental concentrations, for both with and without control measures scenarios, are shown in **Figures 7-5 to 7-8** respectively.

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Predicted PM₁₀ incremental concentrations in µg/m³ at the identified sensitive and discrete receptors within 5 km radius of Sepang-Putrajaya Station, for both with control and without control measures scenarios, are tabulated below:

i) With control measures

| Receptor | Existing baseline (µg/m ³) | Incremental concentration (µg/m ³) | | Ambient air concentration (µg/m ³) | |
|-----------------------------------|--|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Putrajaya Diplomatic Precinct, A6 | 23 | 2.4 | 0.2 | 25.4 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

ii) Without control measures

| Receptor | Existing baseline (µg/m ³) | Incremental concentration (µg/m ³) | | Ambient air concentration (µg/m ³) | |
|-----------------------------------|--|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Putrajaya Diplomatic Precinct, A6 | 23 | 121.7 | 7.6 | 144.7 | - |
| MAAQG 2020 Target | | | | 100 | 40 |



Figure 7-5: Maximum 24-hour Average PM₁₀ Incremental Concentration (µg/m³)
With Control Measures: Sepang-Putrajaya Station



Figure 7-6: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Sepang-Putrajaya Station

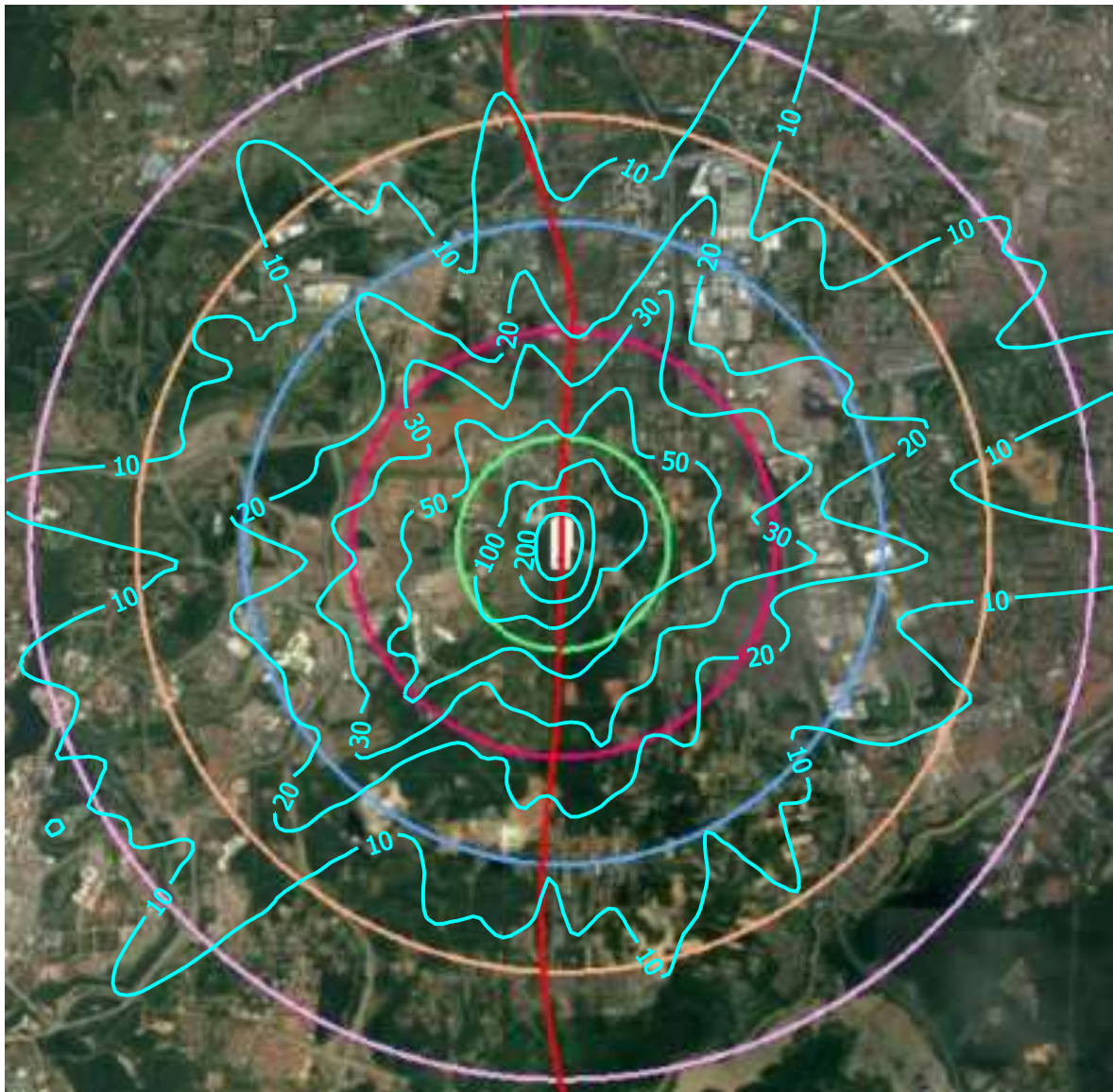


Figure 7-7: Maximum 24-hour Average PM₁₀ Incremental Concentration (µg/m³)
Without Control Measures: Sepang-Putrajaya Station



Figure 7-8: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
Without Control Measures: Sepang-Putrajaya Station

Light Depot and Light Maintenance Base, Serdang

The Light Depot and Light Maintenance Base (LMB), Serdang is to be located within a larger area in comparison to the Bandar Malaysia Station and Sepang-Putrajaya Station. As such the scope of land clearing activities will be comparatively more intensive. Predictive air quality modeling results indicate that higher PM_{10} incremental concentrations will be imposed on surrounding areas compared to the development of the two (2) Stations discussed above. However if dust control measures are inculcated in construction activities, the imposed additional PM_{10} concentrations will not raise ambient PM_{10} levels above the MAAQG target limits. The imposed PM_{10} concentration profiles around the Depot when there dust control measures in place are as shown in **Figures 7-9 to 7-10**. However, in a worst case scenario, when there are no dust control measures adopted during earthwork operations, the predicted maximum 24-hour average PM_{10} concentrations imposed on surrounding areas will raise the current ambient 24 hour average PM_{10} concentrations to be above the corresponding MAAQG target limits in areas up to 2 km from the project site; and up to 1 km from the project site if annual average PM_{10} concentrations are considered (**Figures 7-11 to 7-12**).

Predicted PM_{10} incremental concentrations in $\mu g/m^3$ at the identified sensitive and discrete receptors located within 5 km radius of the Light Depot and Light Maintenance Base, Serdang for both the with control and without control measures scenarios are tabulated below:

CHAPTER 7: EVALUATION OF IMPACTS

i) With control measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|-----------------------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Seri Kembangan Medical Clinic, A4 | 40 | 0.4 | 0.1 | 40.4 | - |
| Light Depot and LMB, A5 | 20 | 9.2 | 0.2 | 29.2 | - |
| Putrajaya Diplomatic Precinct, A6 | 23 | 0.4 | 0.1 | 23.4 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

ii) Without control measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|-----------------------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Seri Kembangan Medical Clinic, A4 | 40 | 16.4 | 0.4 | 46.4 | - |
| Light Depot and LMB, A5 | 20 | 417.1 | 12.3 | 437.1 | - |
| Putrajaya Diplomatic Precinct, A6 | 23 | 20.1 | 0.5 | 43.1 | - |
| MAAQG 2020 Target | | | | 100 | 40 |



Figure 7-9: Maximum 24-hour Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Light Depot + Light Maintenance Base

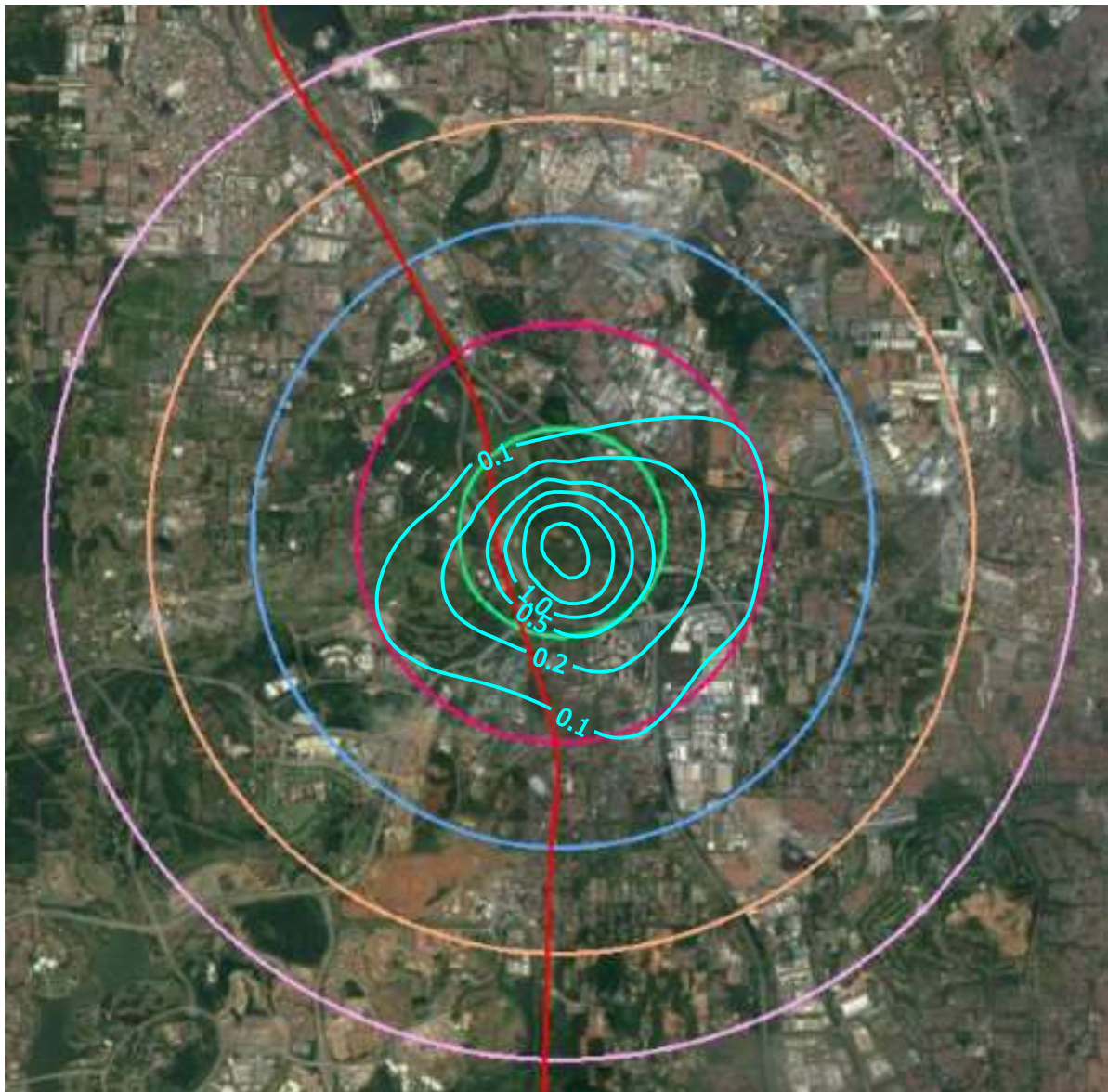


Figure 7-10: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$) With Control Measures: Light Depot + Light Maintenance Base

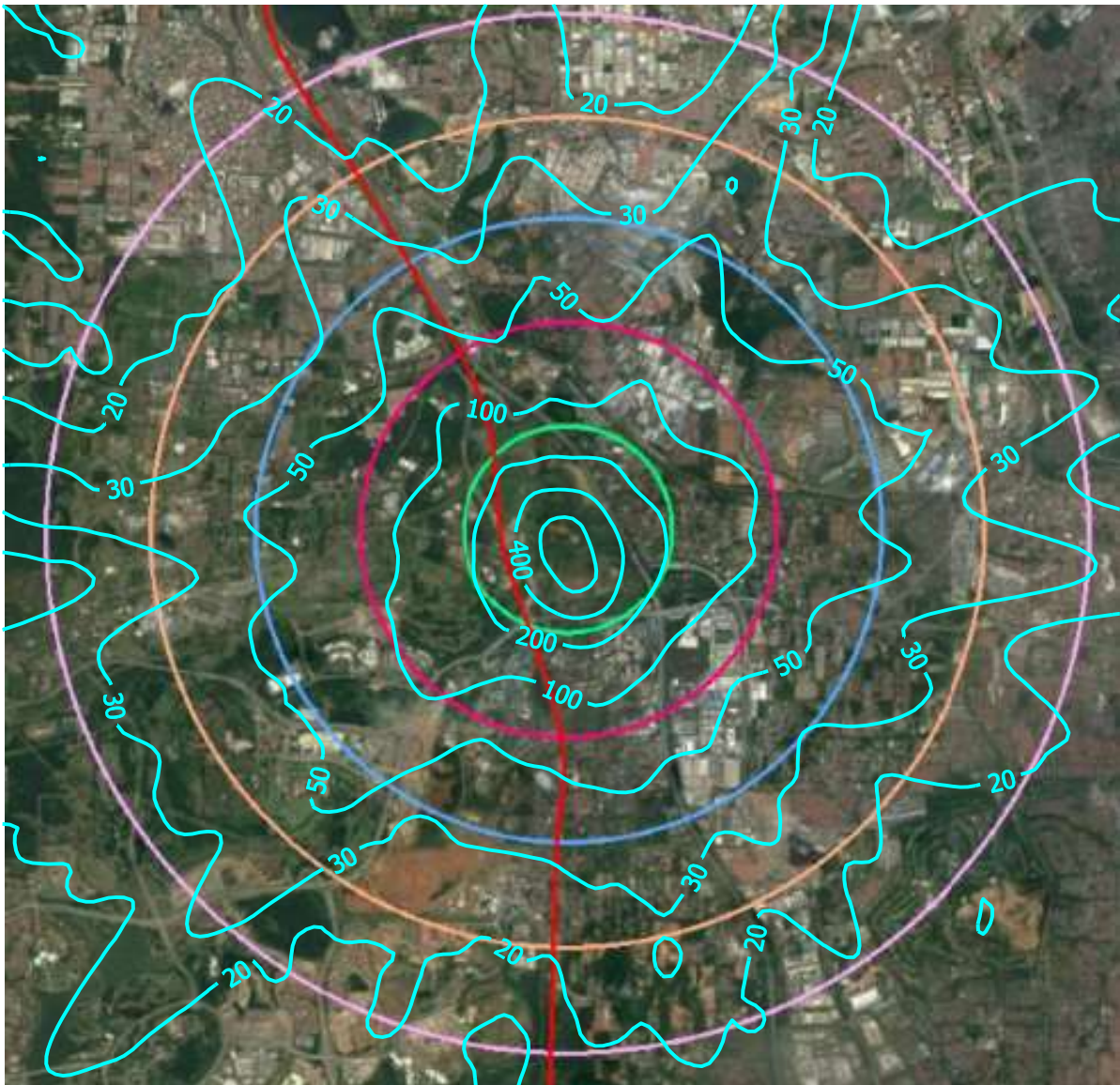


Figure 7-11: Maximum 24-hour Average PM₁₀ Incremental Concentration (µg/m³) Without Control
Measures: Light Depot + Light Maintenance Base

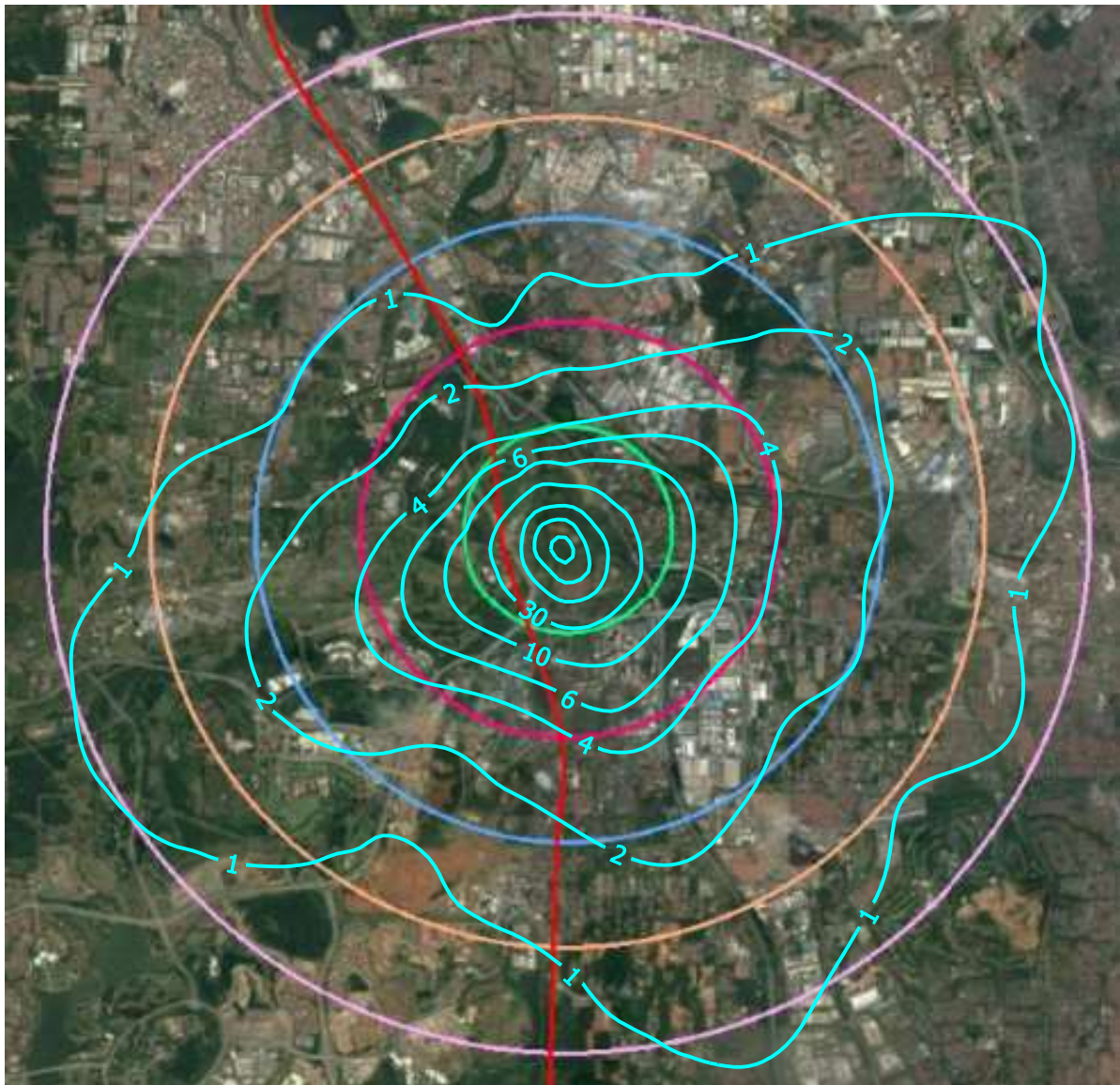


Figure 7-12: Annual Average PM₁₀ Incremental Concentration (µg/m³) Without Control Measures:
Light Depot + Light Maintenance Base

HSR Alignment, FT. Kuala Lumpur/ FT. Putrajaya/Selangor

Construction of the HSR alignment and associated structures (At-Grade, Elevated structures, Bridges and Tunnels) involve smaller working areas and, as expected, potential dust related impacts are minimal especially when there are dust control measures being adopted during construction; and moderate when there are no control measures adopted. Contours representing the maximum 24-hour and annual average PM₁₀ incremental imposed concentrations are shown in **Appendix 7B**.

Predicted PM₁₀ incremental concentrations in µg/m³ at the identified sensitive and discrete receptors located within 5 km radius of the HSR alignment placed within FT. Kuala Lumpur / FT. Putrajaya / Selangor for both the with control and without control measures scenario are tabulated below;

i) With control measures

| Receptor | Existing baseline (µg/m ³) | Incremental concentration (µg/m ³) | | Ambient air concentration (µg/m ³) | |
|--|--|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Taman Serdang Pertama, A3 | 37 | 1.7 | 0.2 | 38.7 | - |
| Seri Kembangan Medical Clinic, A4 | 40 | 6.5 | 1.5 | 46.5 | - |
| Sekolah Menengah Teknik Sepang, A7 | 26 | 0.8 | 0.1 | 26.8 | - |
| SMA Majlis Agama Islam Wilayah Persekutuan | - | 1.72 | 0.25 | - | - |
| Kg. Baru Salak Selatan | - | 8.30 | 3.05 | - | - |
| Sekolah Kebangsaan Desa Petaling, Masjid Al-Khasyiin | - | 8.48 | 3.05 | - | - |

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| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|--------------------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Lakefields Phase 1 | - | 8.34 | 2.85 | - | - |
| DJZ Building | - | 5.39 | 1.23 | - | - |
| UNITEN | - | 8.51 | 3.03 | - | - |
| Sekolah Kebangsaan Sri Serdang | - | 4.08 | 0.90 | - | - |
| SJK (C) Kung Man | - | 1.85 | 0.28 | - | - |
| Kg Dato' Abu Bakar Baginda | - | 8.53 | 3.02 | - | - |
| Sekolah Kebangsaan Desa Putra | - | 3.32 | 0.72 | - | - |
| Kg. Jenderam Hulu | - | 2.05 | 0.34 | - | - |
| MAAQG 2020 Target | | | | 100 | 40 |

ii) Without control measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|--|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Taman Serdang Pertama, A3 | 37 | 83.2 | 11.8 | 120.2 | - |
| Seri Kembangan Medical Clinic, A4 | 40 | 321.2 | 74.6 | 361.2 | - |
| Sekolah Menengah Teknik Sepang, A7 | 26 | 39.7 | 2.4 | 65.7 | - |
| SMA Majlis Agama Islam Wilayah Persekutuan | - | 84.77 | 12.18 | - | - |

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| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|--------------------------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Kg. Baru Salak Selatan | - | 408.88 | 150.47 | - | - |
| SK Desa Petaling, Masjid Al-Khasyiin | - | 418.16 | 150.09 | - | - |
| Lakefields Phase 1 | - | 411.03 | 140.68 | - | - |
| DJZ Building | - | 265.83 | 60.64 | - | - |
| UNITEN | - | 419.36 | 149.58 | - | - |
| Sekolah Kebangsaan Sri Serdang | - | 200.88 | 44.26 | - | - |
| SJK (C) Kung Man | - | 91.04 | 13.92 | - | - |
| Kg Dato' Abu Bakar Baginda | - | 420.34 | 148.89 | - | - |
| Sekolah Kebangsaan Desa Putra | - | 163.70 | 35.63 | - | - |
| Kg. Jenderam Hulu | - | 100.87 | 16.81 | - | - |
| MAAQG 2020 Target | | | | 100 | 40 |

B) Negeri Sembilan

Activities related with the construction of the Seremban Station and the HSR alignments are the only sources of PM₁₀ emissions.

Seremban Station

As predicted for the construction of the Seremban Station, imposed PM₁₀ concentrations on surrounding areas external to the Station will be relatively low especially when dust control measures are adopted. The imposed PM₁₀ concentrations will not cause ambient PM₁₀ concentrations to be raised above the MAAQG target limits for average 24 hour and annual average PM₁₀ concentrations (**Figures 7-13 to 7-14**). As such air quality impacts are expected to be insignificant when there are dust control measures in place. However, air quality impacts will be significant in areas within 1 km of the project site when dust control measures are not adopted. The imposed PM₁₀ concentrations will raise ambient levels of the same pollutant above the MAAQG limits in these areas. Contours of the predicted PM₁₀ concentrations for this scenario are shown in **Figures 7-15 to 7-16**).

Predicted PM₁₀ incremental concentrations in µg/m³ at the identified sensitive and discrete receptors within a 5 km radius of the Seremban Station for both the with control and without control measures scenarios are tabulated below;

i) With control measures

| Receptor | Existing baseline (µg/m ³) | Incremental concentration (µg/m ³) | | Ambient air concentration (µg/m ³) | |
|--------------------------|--|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Kg. Jijan Hulu, A10 | 40 | 0.1 | 0.1 | 40.1 | - |
| MPOB POMTEC, Labu, A11 | 41 | 0.2 | 0.1 | 41.2 | - |
| Taman Cernai Impian, A12 | 28 | 0.3 | 0.1 | 28.3 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

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ii) Without control measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|--------------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Kg. Jijan Hulu, A10 | 40 | 4.6 | 0.1 | 44.6 | - |
| MPOB POMTEC, Labu, A11 | 41 | 12.1 | 0.2 | 53.1 | - |
| Taman Cernai Impian, A12 | 28 | 14.9 | 0.5 | 42.9 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

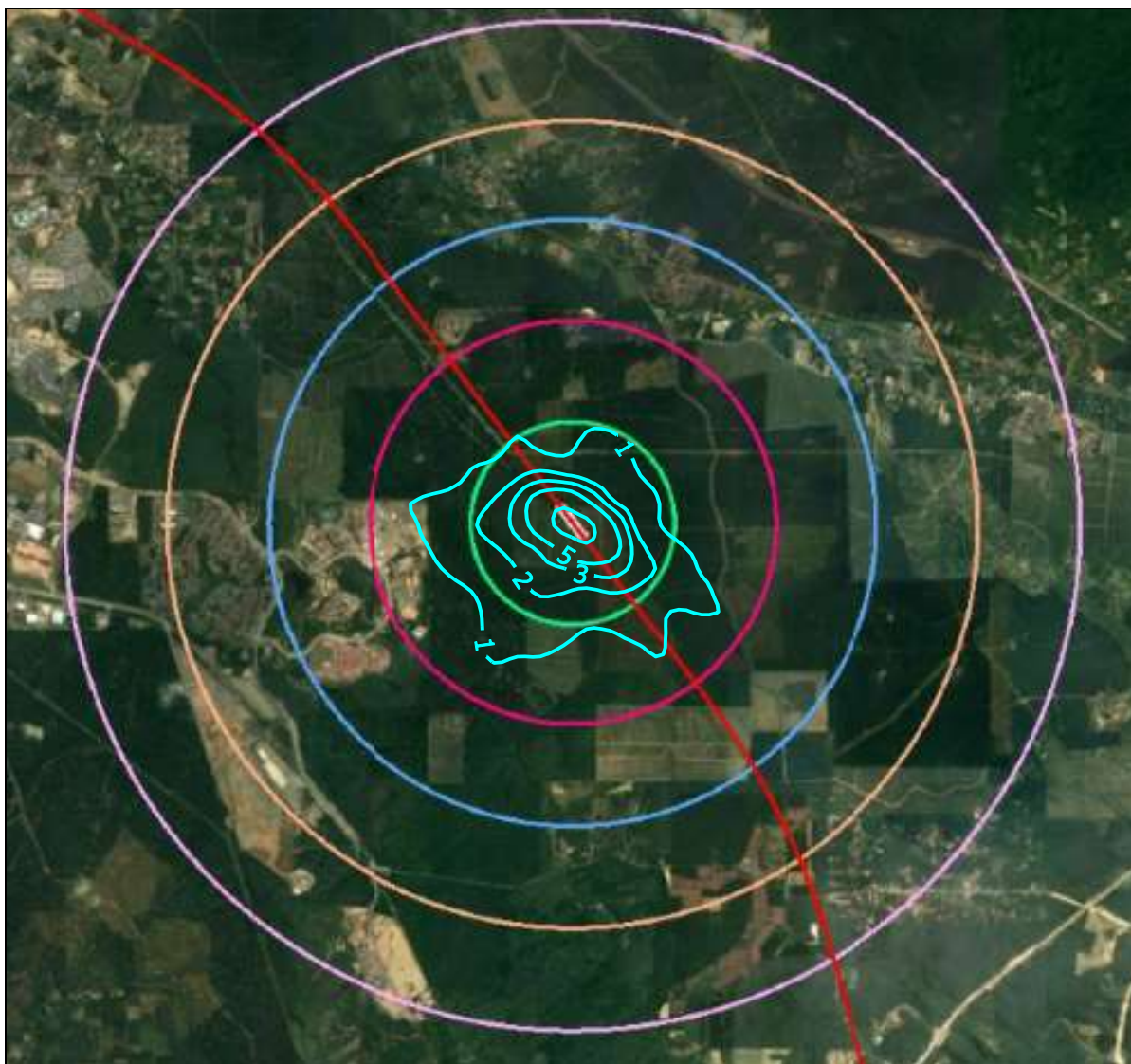


Figure 7-13: Maximum 24-hour Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Seremban Station

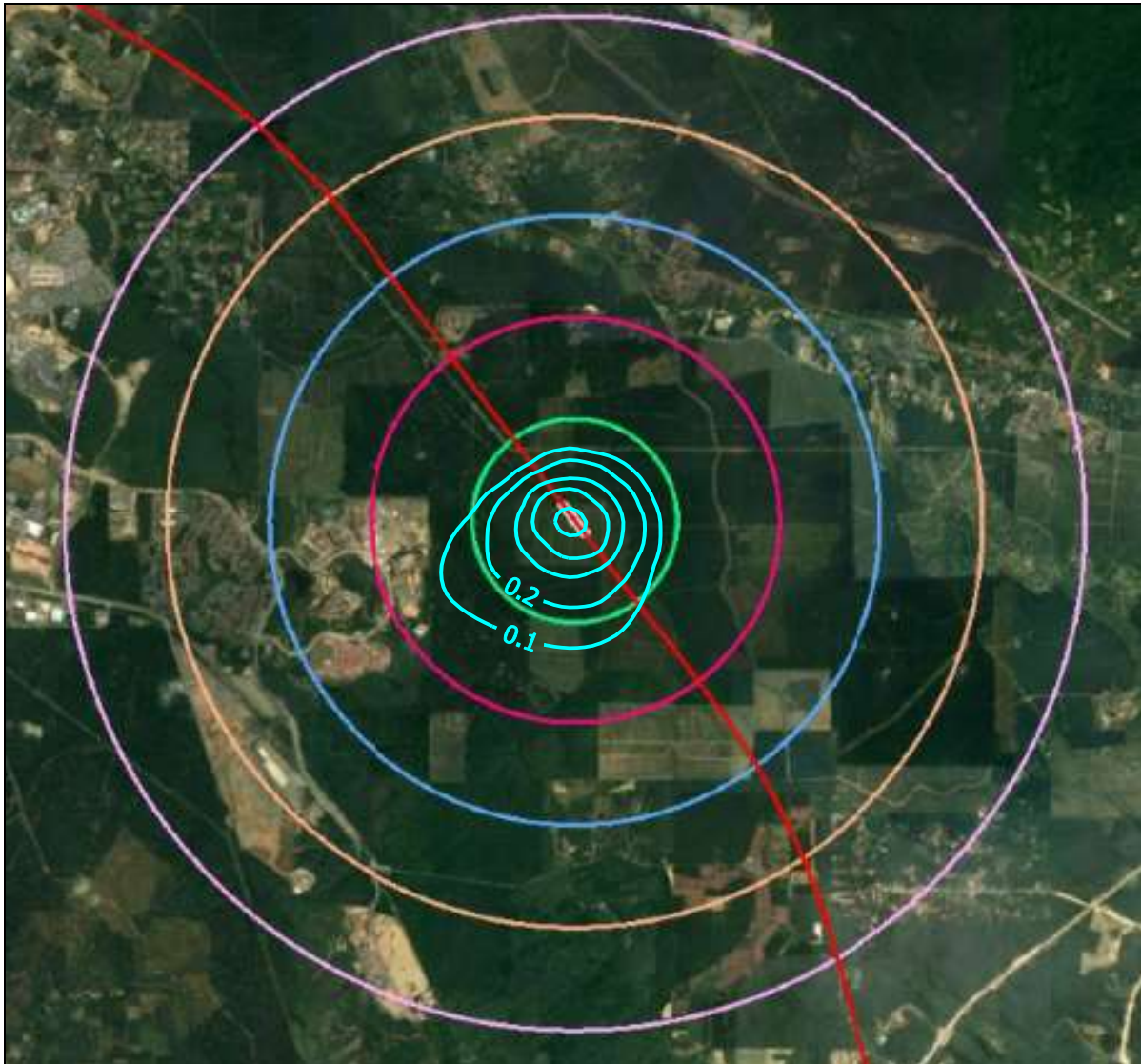


Figure 7-14: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Seremban Station

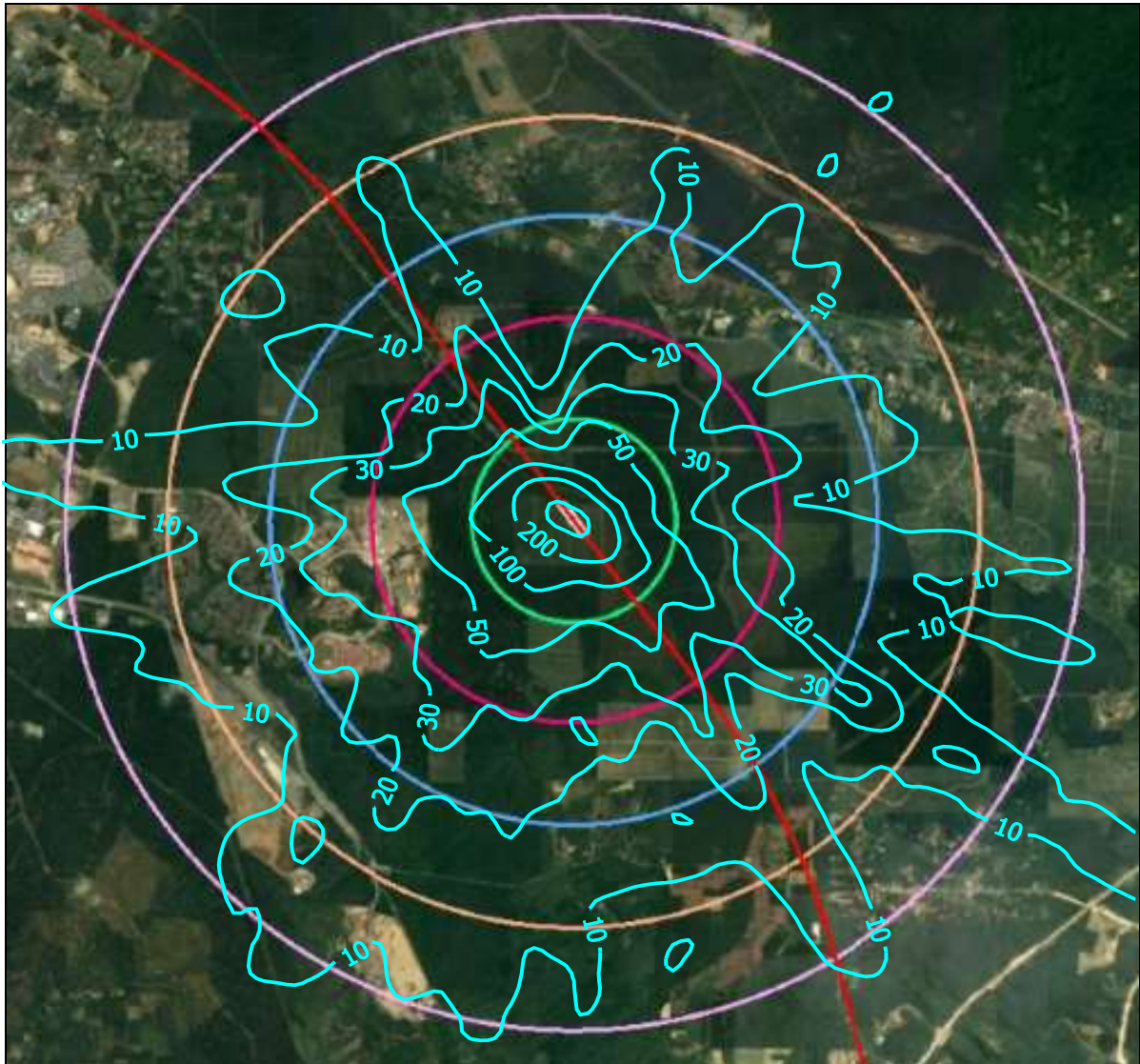


Figure 7-15: Maximum 24-hour Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
Without Control Measures: Seremban Station

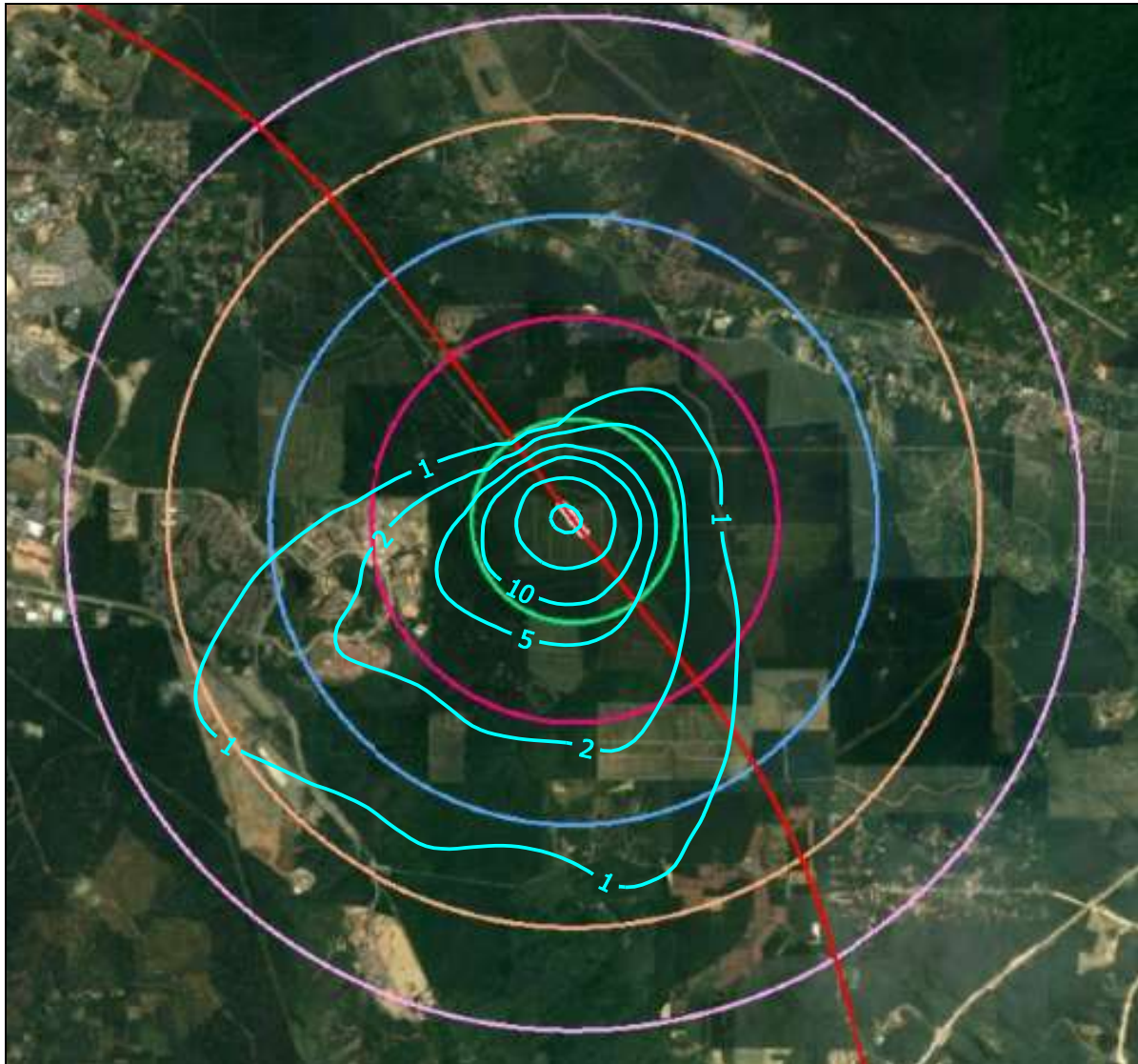


Figure 7-16: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
Without Control Measures: Seremban Station

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HSR Alignment, Negeri Sembilan

As with the case of the FT. Kuala Lumpur / FT. Putrajaya / Selangor sector, impacts of construction activities along the HSR alignment in Negeri Sembilan will be minimal when dust control measures are adopted; and be moderate in intensity when there are no dust control measures adopted during construction of the railway line. Contours for the maximum 24-hour and annual average PM₁₀ incremental concentrations are shown in **Appendix 7C**.

Predicted PM₁₀ incremental concentrations in µg/m³ at the identified sensitive and discrete receptors located within 5 km radius of the HSR alignment, Negeri Sembilan for both the with control and without control measures scenarios are tabulated below;

i) With Control Measures

| Receptor | Existing baseline (µg/m ³) | Incremental concentration (µg/m ³) | | Ambient air concentration (µg/m ³) | |
|-------------------------------|--|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Taman Desa Bestari, A8 | 26 | 0.9 | 0.1 | 26.9 | - |
| KPJ Healthcare University, A9 | 34 | 2.7 | 0.5 | 36.7 | - |
| Kg. Jijan Hulu, A10 | 40 | 0.5 | 0.1 | 40.5 | - |
| Kg. Sendayan, A13 | 30 | 1.1 | 0.1 | 31.1 | - |
| Taman Sg. Ujong, A14 | 27 | 1.3 | 0.1 | 28.3 | - |
| Taman Seri Aman, A15 | 45 | 0.8 | 0.1 | 45.8 | - |
| SMK Sendayan | - | 7.86 | 3.20 | - | - |
| Kg. Sg. Sendayan | - | 7.81 | 3.15 | - | - |
| Hindu Temple | - | 0.99 | 0.07 | - | - |
| MAAQG 2020 Target | | | | 100 | 40 |

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ii) Without Control Measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|-------------------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Taman Desa Bestari, A8 | 26 | 43.8 | 2.6 | 69.8 | - |
| KPJ Healthcare University, A9 | 34 | 133.4 | 27.1 | 167.4 | - |
| Kg. Jijan Hulu, A10 | 40 | 22.8 | 0.9 | 62.8 | - |
| Kg. Sendayan, A13 | 30 | 53.9 | 4.1 | 83.9 | - |
| Taman Sg. Ujong, A14 | 27 | 62.4 | 5.7 | 89.4 | - |
| Taman Seri Aman, A15 | 45 | 41.6 | 2.4 | 86.6 | - |
| SMK Sendayan | - | 387.15 | 157.86 | - | - |
| Kg. Sg. Sendayan | - | 384.74 | 155.28 | - | - |
| Hindu Temple | - | 48.98 | 3.35 | - | - |
| MAAQG 2020 Target | | | | 100 | 40 |

C) Melaka

The construction of the Melaka Station, and the HSR alignment through the State, are activities that are expected to induce localized dust particulates to become airborne, which are then capable of being dispersed to adjacent localities, under favorable weather conditions, causing potential nuisance conditions to be imposed on surrounding sensitive receptors.

Modeling of the potential dust dispersion trends around the work sites have been conducted to gauge the potential air quality impacts that can materialize, and the degree of environmental perturbations that can be imposed on external sensitive receptors. The results of the modeling exercise, and the extent of impacts that can arise, are summarized in the following narrative.

Melaka Station

The Melaka Station's land area is of the same size as compared to the Sepang-Putrajaya and Seremban Stations. Therefore the potential dust dispersion trends around this site is expected to be similar in scope and intensity to that elucidated for the previous Stations; considering that the weather patterns at all three mentioned sites are fairly similar. Dust dispersion modeling results showed that impacts on surrounding receptors are insignificant when dust control measures are adopted during site clearance operations when surfaces are left bare. The total predicted 24 hour PM₁₀ concentrations (i.e. ambient concentrations plus imposed PM₁₀ concentrations arising from construction activities), at sites surrounding the Station site are within the MAAQG target limits as shown in **Figures 7-17 to 7-18**. On the other hand, if dust control measures are not adopted at the construction site, then the predicted cumulative 24 hour PM₁₀ concentrations will exceed the MAAQG limits impacts at areas within approximately 1.5 km from the project site. Contours of the predicted PM₁₀ concentrations for this scenario are shown in **Figures 7-19 to 7-20**.

Predicted PM₁₀ incremental concentrations, expressed as µg/m³, at the identified sensitive and discrete receptors within a 5 km radius of the Melaka Station for both the with control and without control measures scenario are tabulated below;

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i) With Control Measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|----------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Cempaka Heights, A19 | 40 | 1.3 | 0.1 | 41.3 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

ii) Without Control Measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|----------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Cempaka Heights, A19 | 40 | 66.1 | 1.2 | 106.1 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

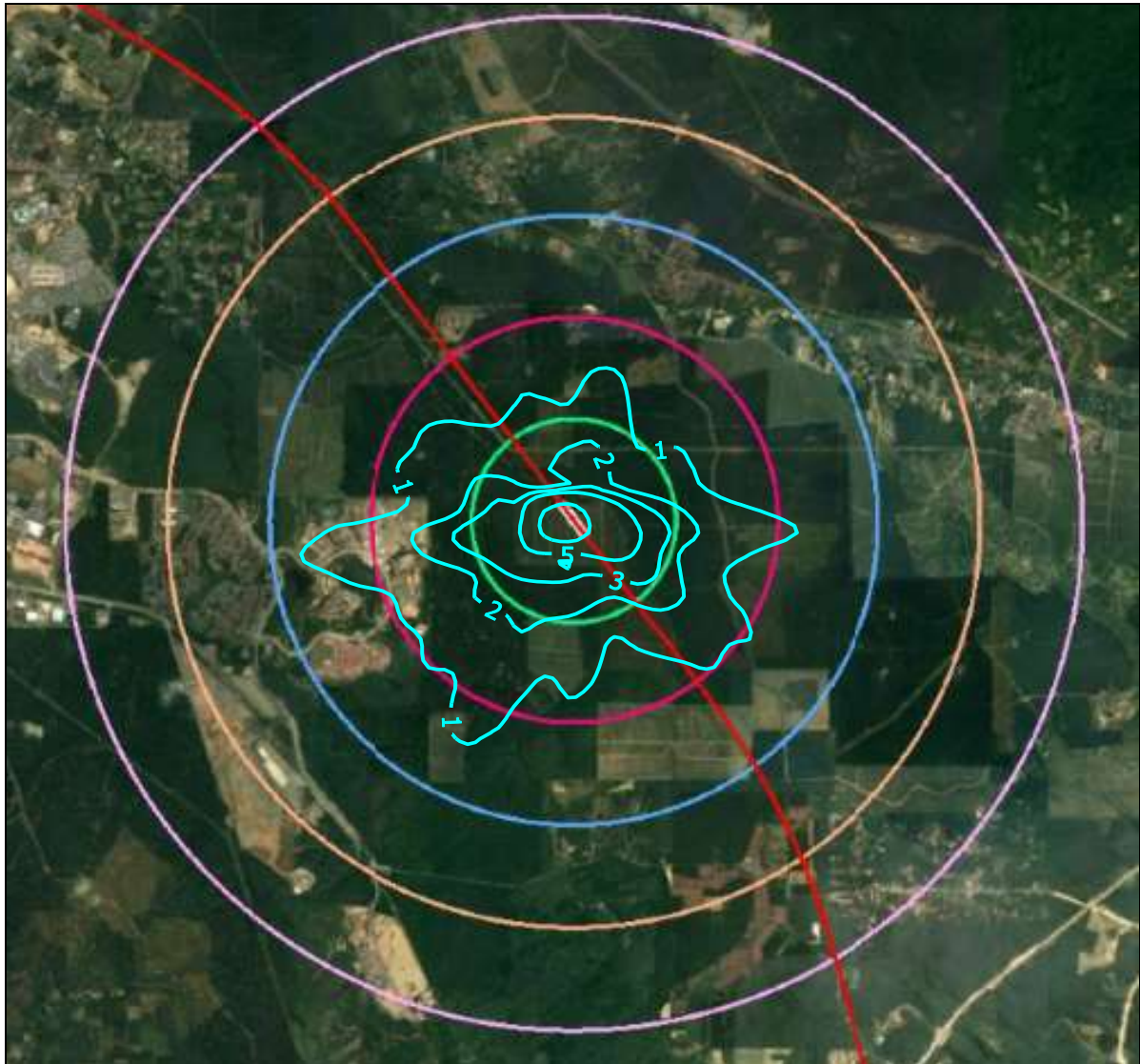


Figure 7-17: Maximum 24-hour Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Melaka Station

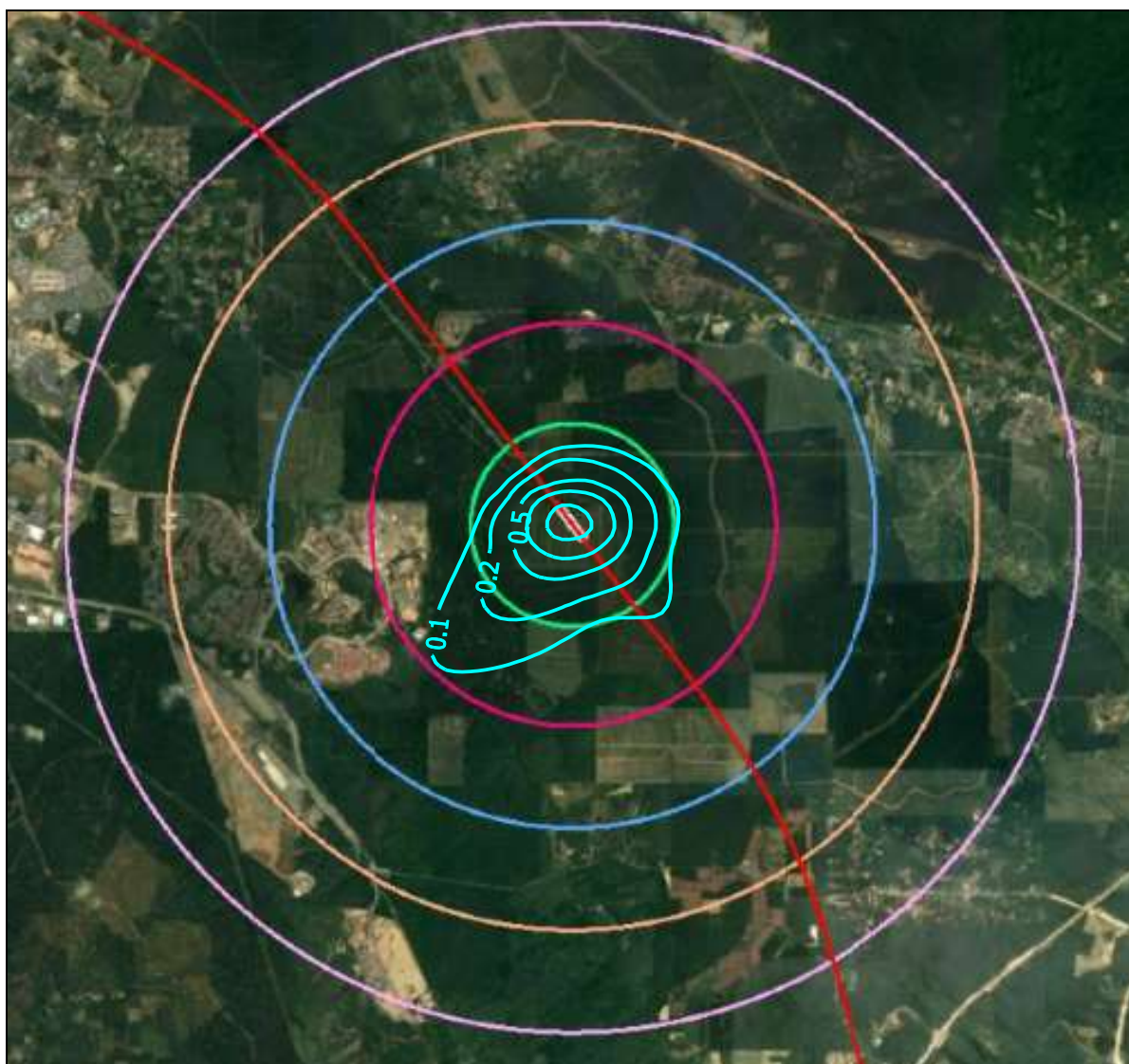


Figure 7-18: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Melaka Station

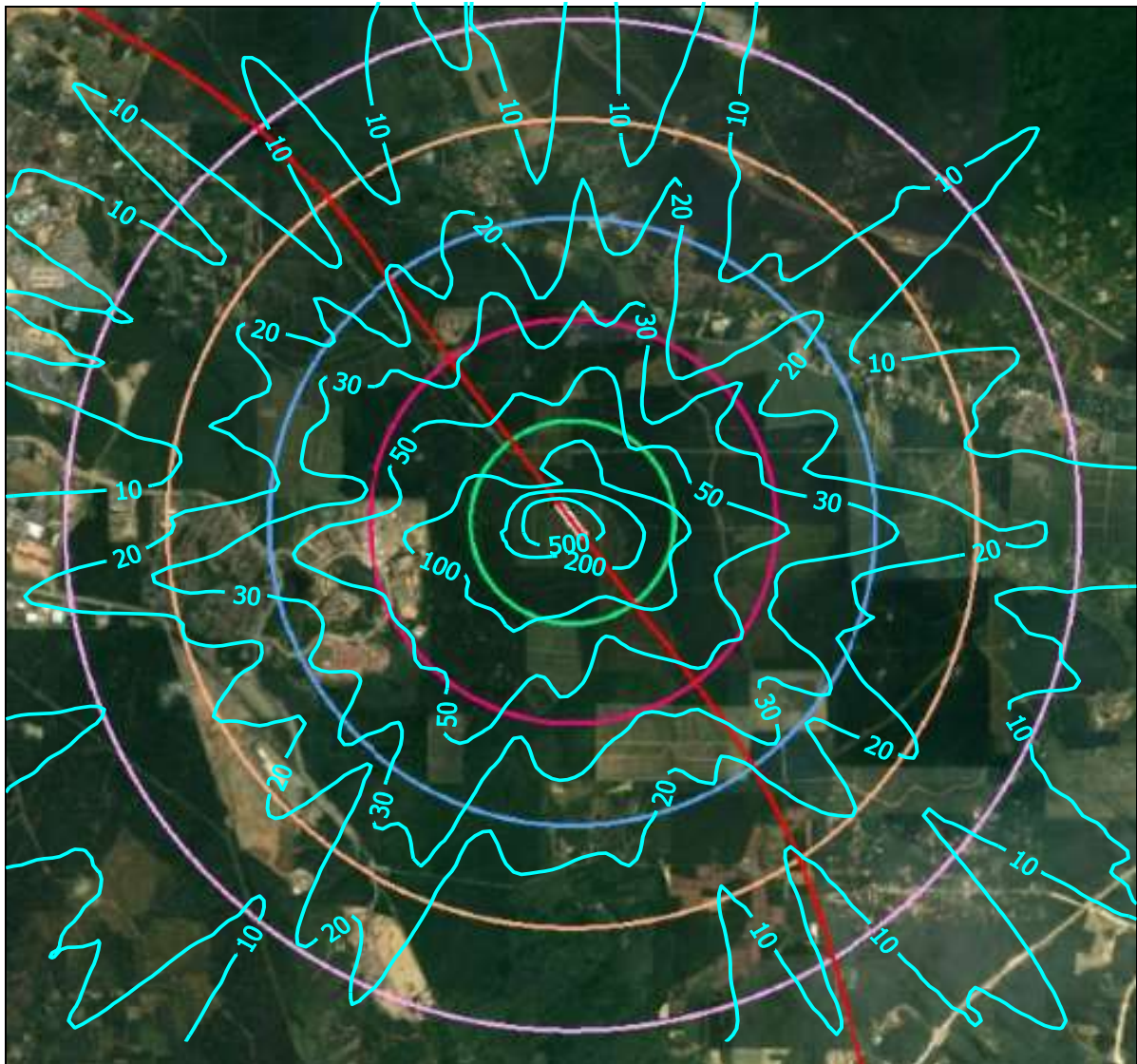


Figure 7-19: Maximum 24-hour Average PM₁₀ Incremental Concentration (µg/m³)
Without Control Measures: Melaka Station

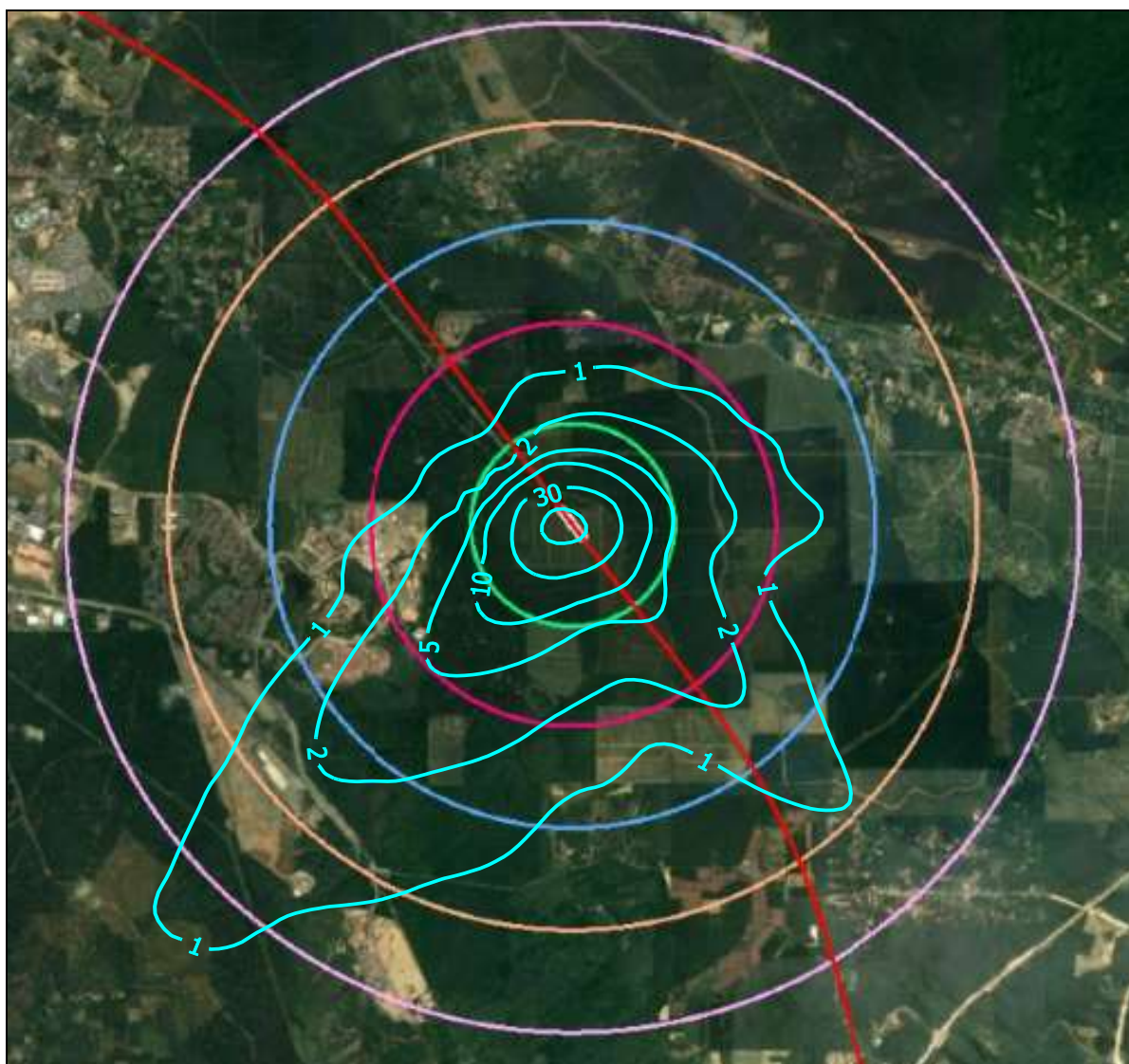


Figure 7-20: Annual Average PM₁₀ Incremental Concentration (µg/m³)
Without Control Measures: Melaka Station

HSR Alignment, Melaka

Dust dispersion tendencies, and subsequent dispersion to surrounding areas, arising from site preparation and land clearing activities along the HSR alignment have been shown to be minimal if, and only if, dust control measures are adopted rigorously (Refer to the FT. Kuala Lumpur / FT. Putrajaya / Selangor and Negeri Sembilan predictive analysis). A similar consequence is predicted for the construction of the alignment within Melaka. If dust control measures are not systematically adopted at the construction sites, then modeling studies

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have predicted that moderate to severe PM₁₀ impacts will be imposed on surrounding nearby sensitive receptors.

Contours for the average 24-hour and annual average PM₁₀ incremental concentrations are shown in **Appendix 7D**.

Predicted PM₁₀ incremental concentrations in µg/m³ at the identified sensitive and discrete receptors within a 5 km radius of the HSR alignment, for both the with control and without control measures scenarios, are tabulated below;

i) With Control Measures

| Receptor | Existing baseline (µg/m ³) | Incremental concentration (µg/m ³) | | Ambient air concentration (µg/m ³) | |
|--|--|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Kg. Solok Air Limau, A16 | 41 | 1.9 | 0.1 | 42.9 | - |
| Kg. Durian Daun, A17 | 49 | 4.6 | 1.4 | 53.6 | - |
| 1 Krubong Residence, A18 | 56 | 2.0 | 0.1 | 58.0 | - |
| Taman Bemban Baru, A20 | 57 | 4.5 | 1.0 | 61.5 | - |
| Open space / palm oil plantation, A21, | 28 | 1.9 | 0.1 | 29.9 | - |
| Kg. Seri Mendapat, A22 | 44 | 1.3 | 0.1 | 45.3 | - |
| IKBN Alor Gajah | - | 5.65 | 1.69 | - | - |
| Taman Paya Rumpit Indah | - | 7.40 | 2.06 | - | - |
| Pusat Rehabilitasi Perkeso | - | 3.53 | 0.63 | - | - |
| Masjid Nurul Iman | - | 7.26 | 2.04 | - | - |
| MAAQG 2020 Target | | | | 100 | 40 |

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ii) Without Control Measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|--|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Kg. Solok Air Limau, A16 | 41 | 94.3 | 2.6 | 135.3 | - |
| Kg. Durian Daun, A17 | 49 | 225.9 | 68.5 | 247.9 | - |
| 1 Krubong Residence, A18 | 56 | 96.5 | 2.8 | 152.5 | - |
| Taman Bemban Baru, A20 | 57 | 222.4 | 49.6 | 279.4 | - |
| Open space / palm oil plantation, A21, | 28 | 94.2 | 2.6 | 122.2 | - |
| Kg. Seri Mendapat, A22 | 44 | 65.6 | 1.0 | 109.6 | - |
| IKBN Alor Gajah | - | 278.44 | 83.18 | - | - |
| Taman Paya Rumput Indah | - | 364.82 | 101.63 | - | - |
| Pusat Rehabilitasi Perkeso | - | 190.91 | 34.54 | - | - |
| Masjid Nurul Iman | - | 357.78 | 100.34 | - | - |
| MAAQG 2020 Target | | | | 100 | 40 |

D) Johor

Suspended Particulate (Dust) Impact assessment for the Johor sector encompasses the construction of the following facilities, especially during the land clearing and earthworks stages, viz: (i) two (2) stations at Muar and Batu Pahat, (ii) Heavy Maintenance Base (HMB), Muar (iii) Iskandar Puteri Station, (iv) Main Depot and LMB, Pontian and (v) the HSR alignment.

Muar Station

Muar Station which is of similar size to the Seremban and Melaka Stations is predicted to induce similar scope and degree of dust impacts on surrounding Receptors as the other two stations. With dust control measures implemented during construction of the Station, the predicted maximum 24-hour average, and annual average, cumulative PM₁₀ concentrations (i.e. imposed plus ambient concentrations) fall within the MAAQG limits for these two parameters. Contours of the predicted maximum 24-hour average and annual average PM₁₀ incremental concentrations are shown in **Figures 7-21 and 7-22** respectively. However when there are no dust control measures adopted during construction activities, the predicted cumulative PM₁₀ concentrations are above the maximum 24-hour average limit of 100 µg/m³ in areas up to approximately 1.5 km from the project site; and above the annual average limit of 40 µg/m³ in areas up to approximately 500 m from the project site. Contours of the predicted maximum 24-hour average and annual average PM₁₀ incremental concentrations for the no control measures scenario are shown in **Figures 7-23 and 7-24** respectively.

The predicted PM₁₀ incremental concentrations in µg/m³ at the identified sensitive and discrete receptors within a 5 km radius of Muar Station for both the with control and without control measures scenarios for are tabulated below;

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i) With Control Measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|-----------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Kg. Jawa Panchor, A25 | 27 | 0.6 | 0.1 | 27.6 | - |
| Muar Station, A26 | 20 | 9.2 | 1.7 | 29.2 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

ii) Without Control Measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|-----------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Kg. Jawa Panchor, A25 | 27 | 29.9 | 0.3 | 56.9 | - |
| Muar Station, A26 | 20 | 459.3 | 82.6 | 479.3 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

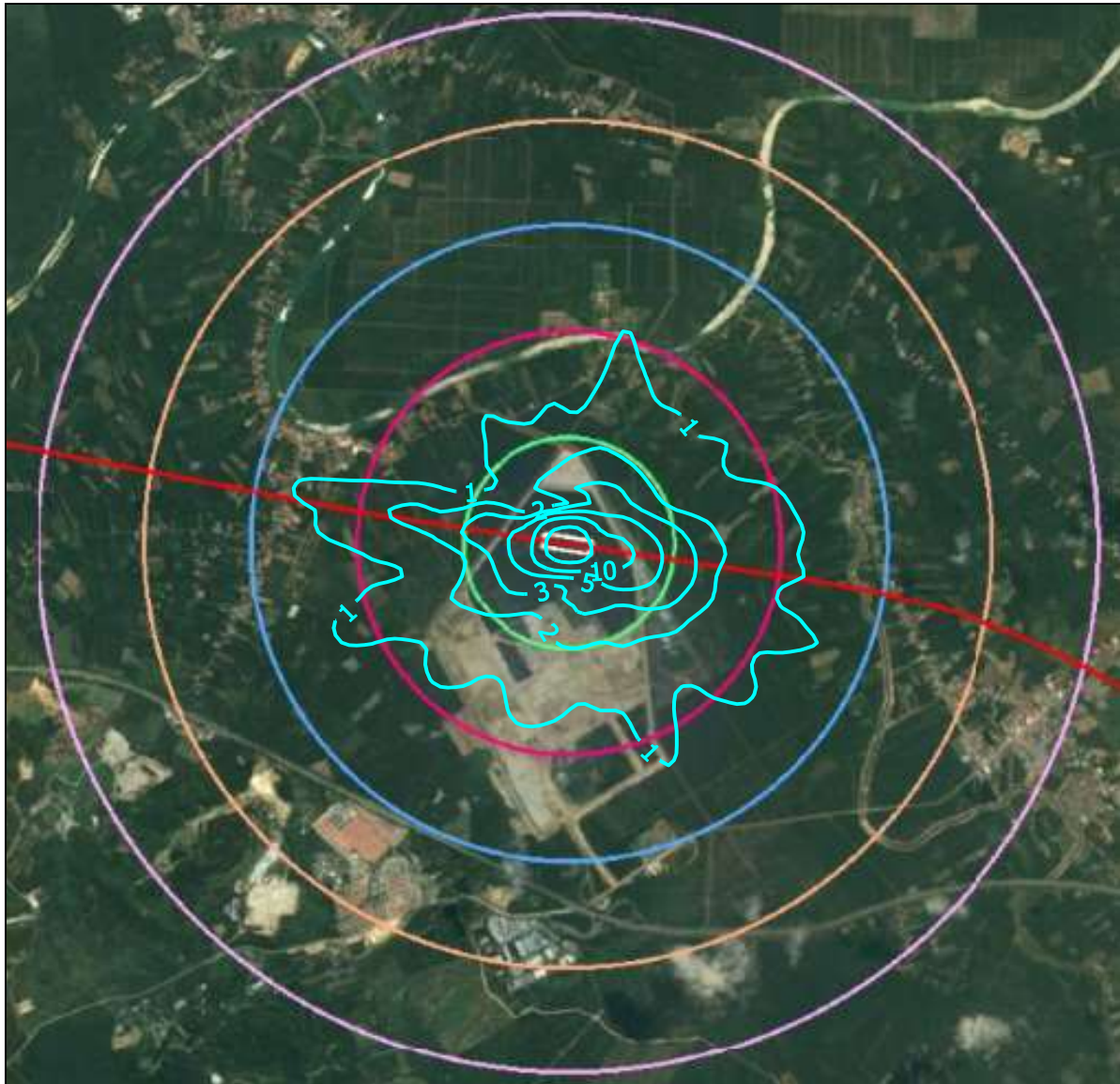


Figure 7-21: Maximum 24-hour Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Muar Station

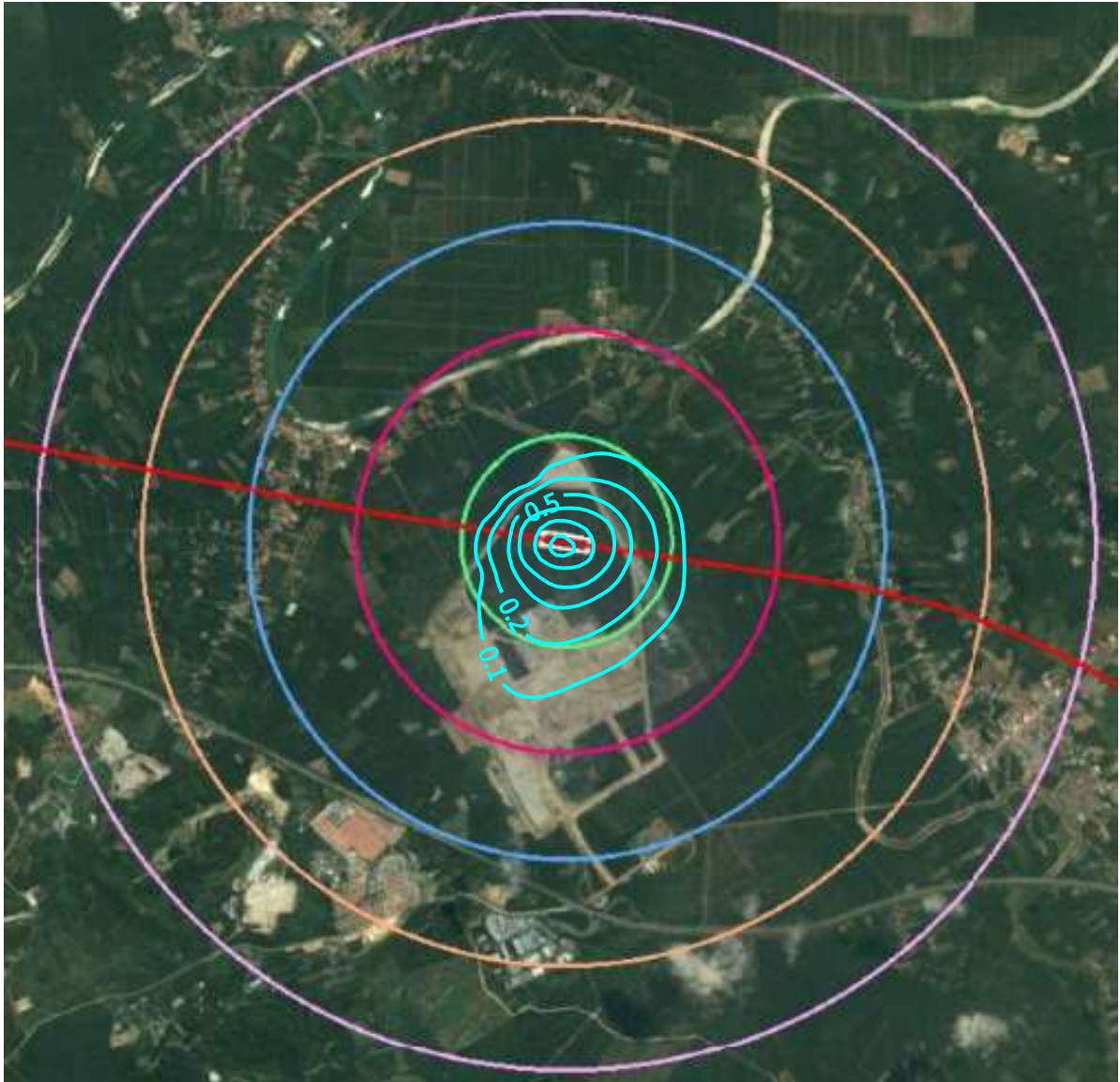


Figure 7-22: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Muar Station

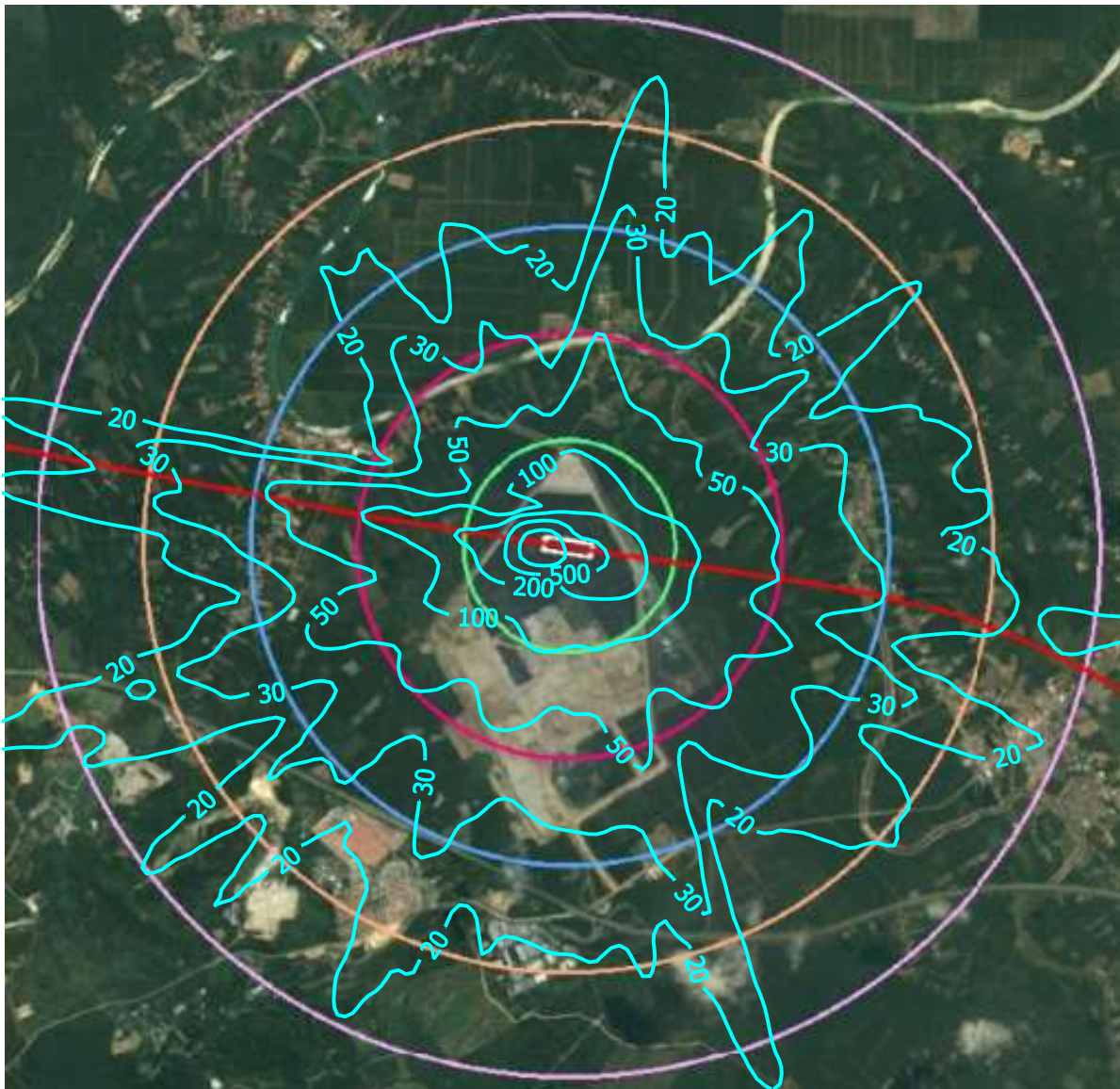


Figure 7-23: Maximum 24-hour Average PM₁₀ Incremental Concentration (µg/m³)
Without Control Measures: Muar Station

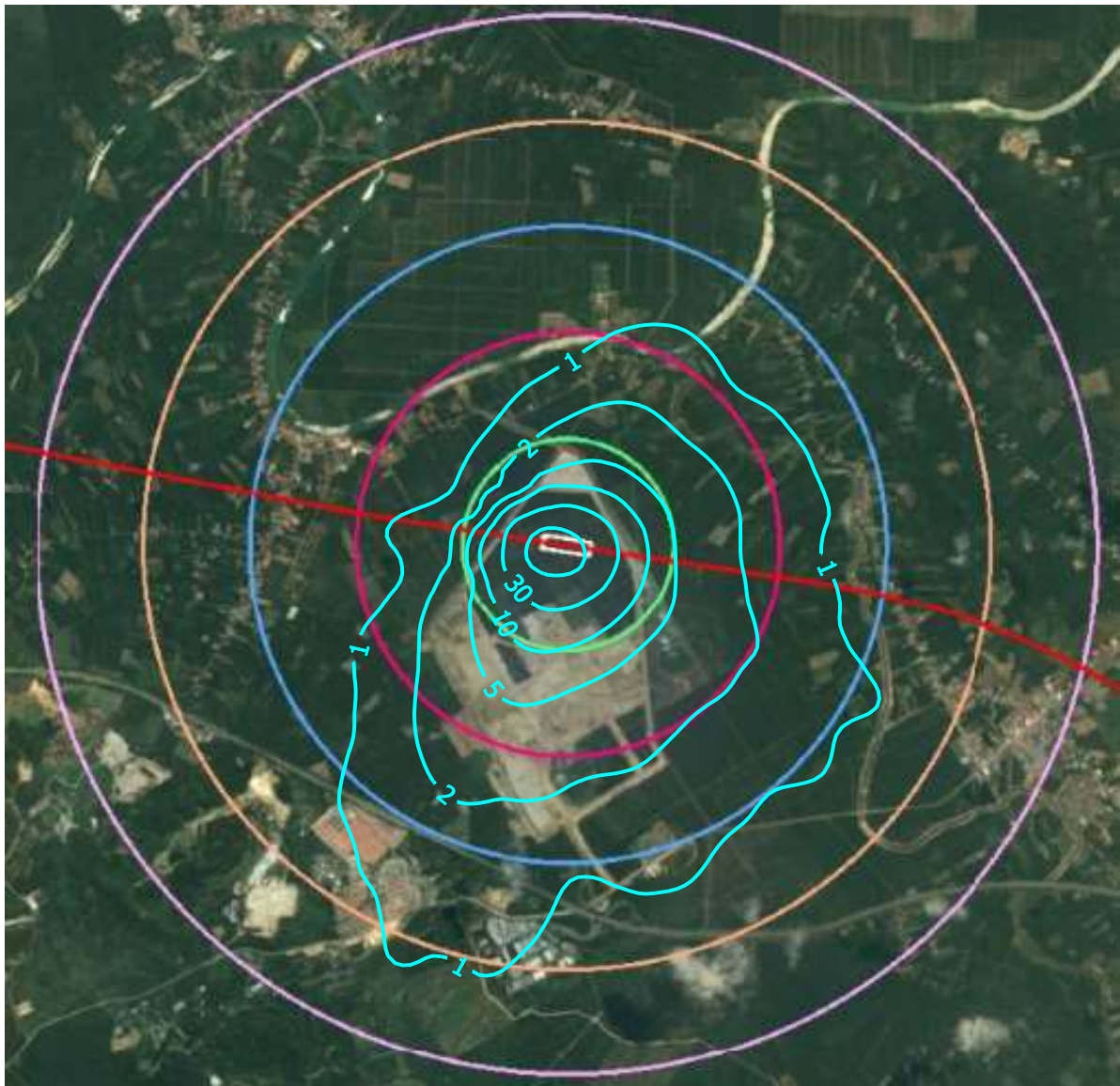


Figure 7-24: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
Without Control Measures: Muar Station

Heavy Maintenance Base, Muar

With a land area of 10 ha, construction activities at the heavy maintenance base site in Muar will have only slight impacts on degrading the air quality status in the surrounding areas. This is the case when there are dust control measures being adopted within the site. The cumulative predicted average PM₁₀ concentrations fall below the MAAQG limits. This is depicted in **Figures 7-25 and 7-26** for the maximum 24-hour average and annual average PM₁₀ incremental concentration respectively. In the case when there are no dust control measures being applied within the site, predicted PM₁₀ concentrations are above the MAAQG limits up to as much as 5 km from the project site for the maximum 24-hour average PM₁₀ concentration. The maximum 24-hour average and annual average PM₁₀ incremental and cumulative concentrations for the no control measures scenario are shown in **Figures 7-27 and 7-28** respectively.

The predicted PM₁₀ incremental and cumulative concentrations in µg/m³ at the identified sensitive and discrete receptors within a 5 km radius of the Heavy Maintenance Base, Muar for both the with control and without control measures scenario are tabulated below;

i) With Control Measures

| Receptor | Existing baseline (µg/m ³) | Incremental concentration (µg/m ³) | | Ambient air concentration (µg/m ³) | |
|-----------------------|--|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Kg. Jawa Panchor, A25 | 27 | 7.2 | 0.1 | 34.2 | - |
| Muar Station, A26 | 20 | 11.3 | 0.1 | 31.3 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

ii) Without Control Measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|-----------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Kg. Jawa Panchor, A25 | 27 | 361.6 | 3.0 | 388.6 | - |
| Muar Station, A26 | 20 | 567.3 | 5.4 | 577.3 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

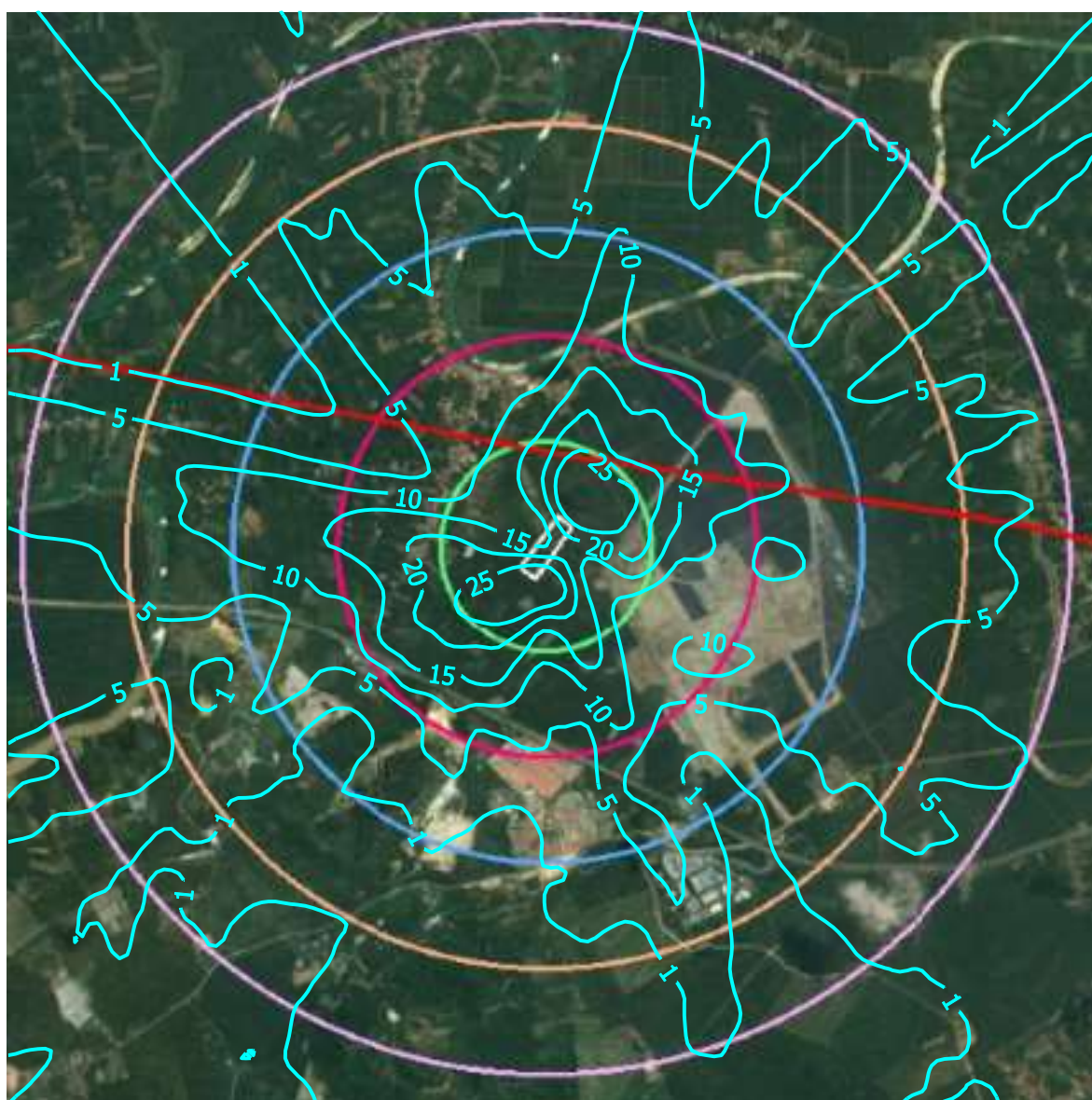


Figure 7-25: Maximum 24-hour Average PM_{10} Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Heavy Maintenance Base

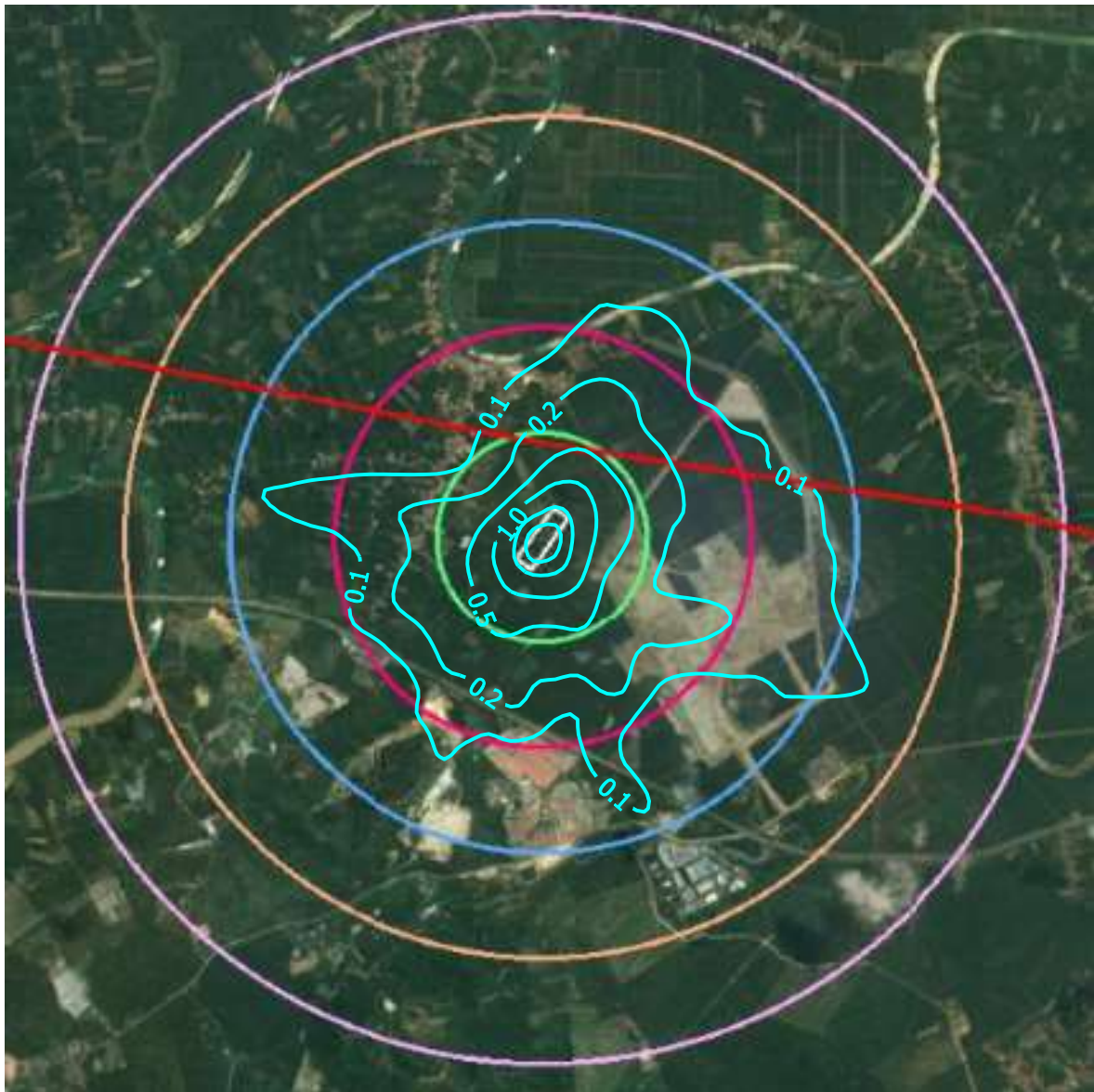


Figure 7-26: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Heavy Maintenance Base

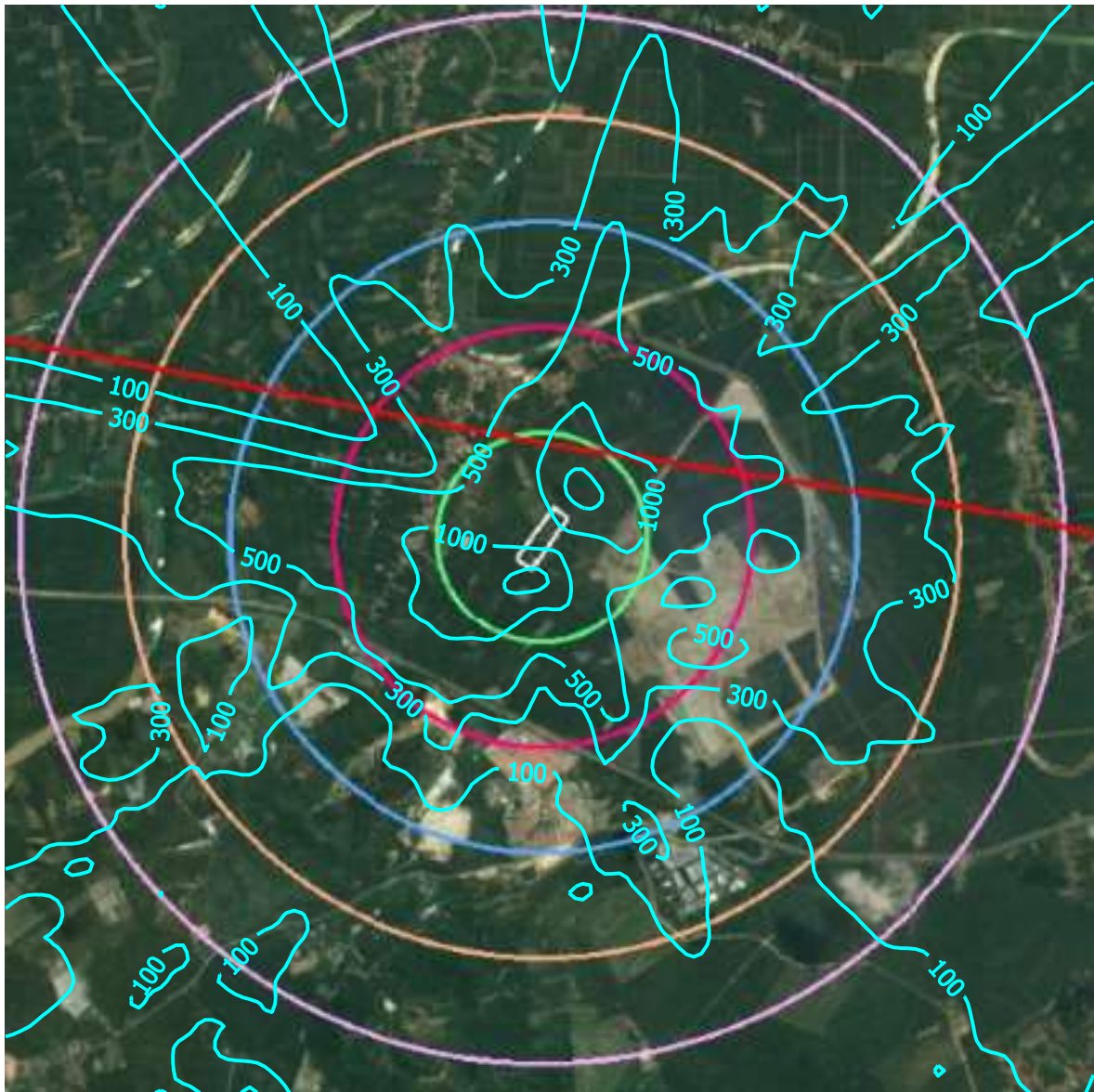


Figure 7-27: Maximum 24-hour Average PM₁₀ Incremental Concentration (µg/m³)
Without Control Measures: Heavy Maintenance Base

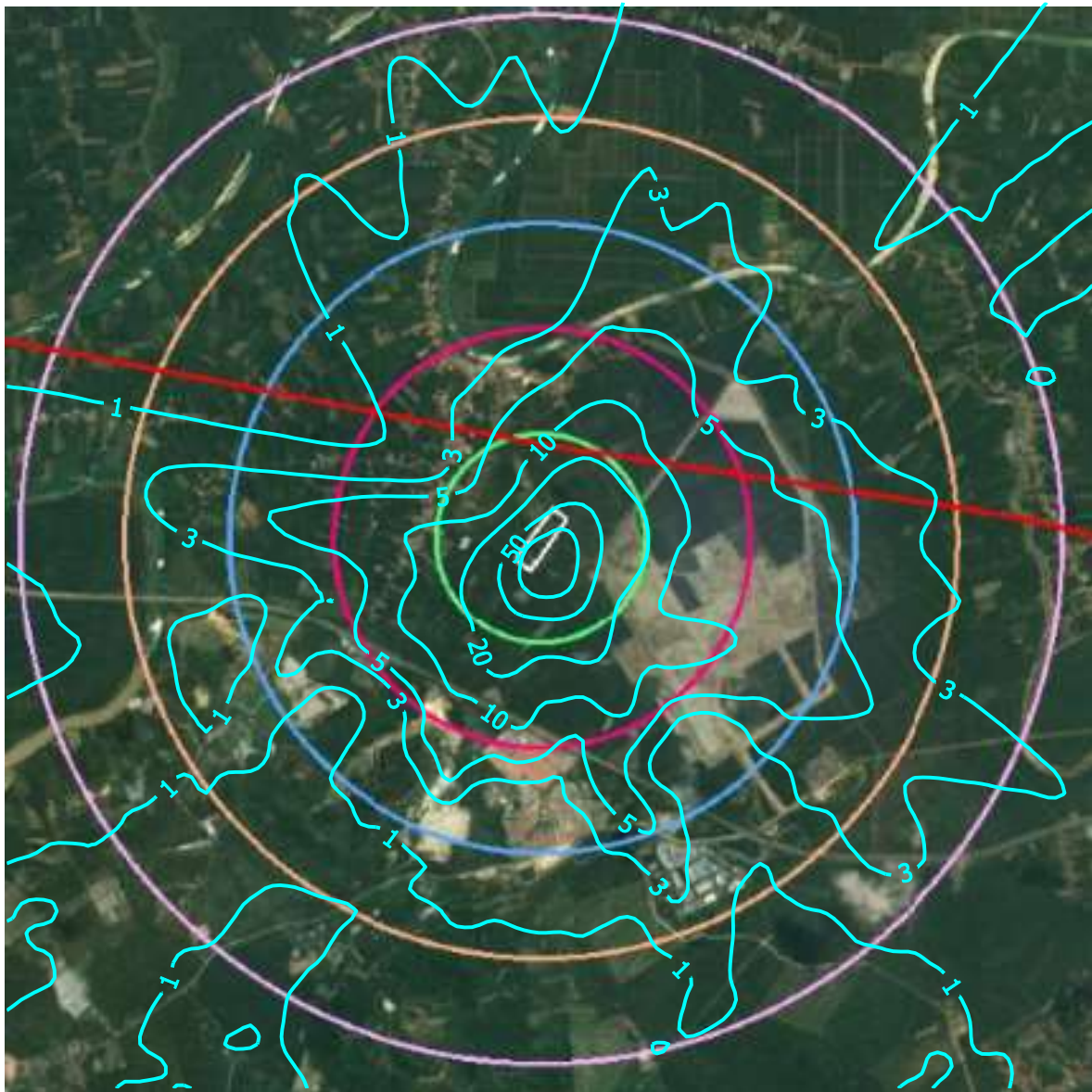


Figure 7-28: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
Without Control Measures: Heavy Maintenance Base

Batu Pahat Station

As with construction of all the previous intermediate Stations, it is predicted that construction activities conducted within the Batu Pahat Station site will not impose PM₁₀ concentrations in surrounding areas such that the corresponding ambient levels in these areas will be made to increase above the MAAQG limits for PM₁₀. This will be true only if dust control measures are adopted during construction activities. The modeling results are portrayed in **Figures 7-29 and 7-30** for the maximum 24-hour average and annual average PM₁₀ concentrations respectively. Similarly, when there are no dust control measures adopted, the MAAQG limits are exceeded in areas up to approximately 1.5 km from the project site with respect to the maximum 24-hour average concentration as shown in **Figure 7-31**; and up to approximately 500 m for the annual average concentration case as shown in **Figure 7-32**.

The predicted PM₁₀ incremental concentrations, expressed in µg/m³, at the identified sensitive and discrete receptors within a 5 km radius of the Batu Pahat Station for both the with control and without control measures scenarios are tabulated below;

i) With Control Measures

| Receptor | Existing baseline (µg/m ³) | Incremental concentration (µg/m ³) | | Ambient air concentration (µg/m ³) | |
|---------------------------------------|--|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Kawasan Perindustrian Sri Gading, A28 | 54 | 0.8 | 0.1 | 54.8 | - |
| Batu Pahat Station, A29 | 44 | 5.8 | 0.4 | 49.8 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

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ii) Without Control Measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|---------------------------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Kawasan Perindustrian Sri Gading, A28 | 54 | 39.8 | 0.7 | 93.8 | - |
| Batu Pahat Station, A29 | 44 | 289.0 | 21.9 | 333.0 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

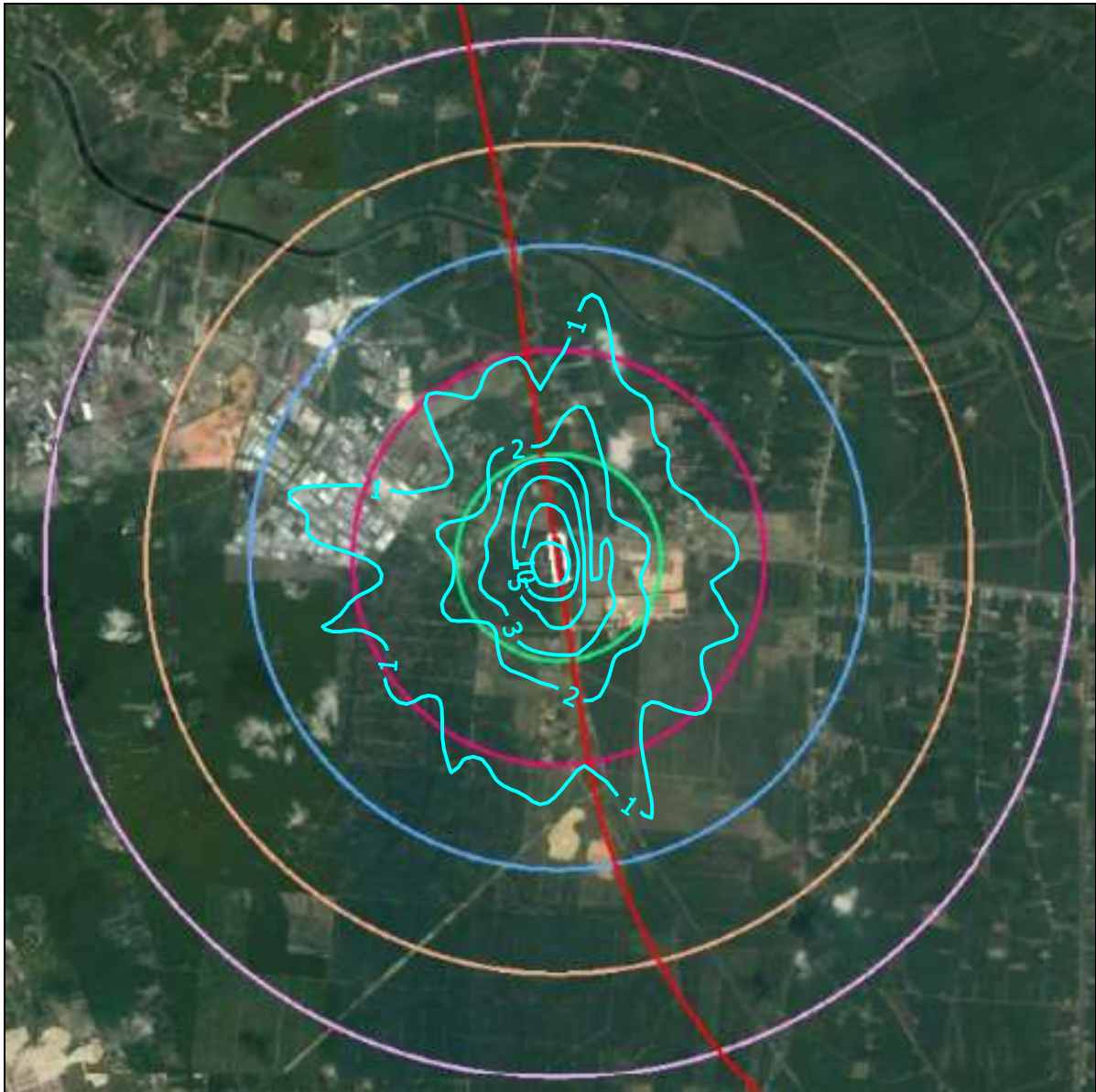


Figure 7-29: Maximum 24-hour Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Batu Pahat Station

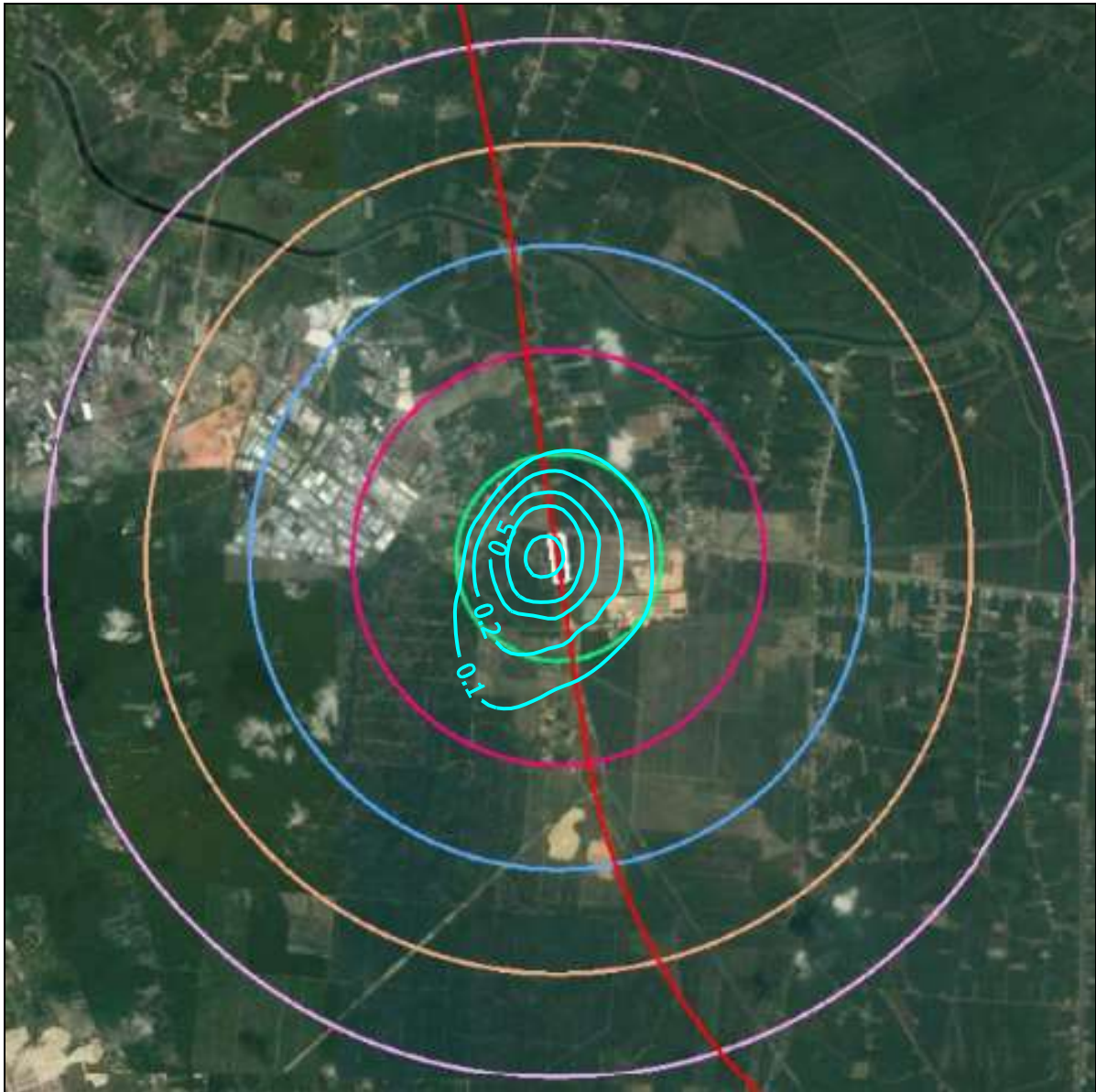


Figure 7-30: Annual Average PM₁₀ Incremental Concentration (µg/m³)
With Control Measures: Batu Pahat Station

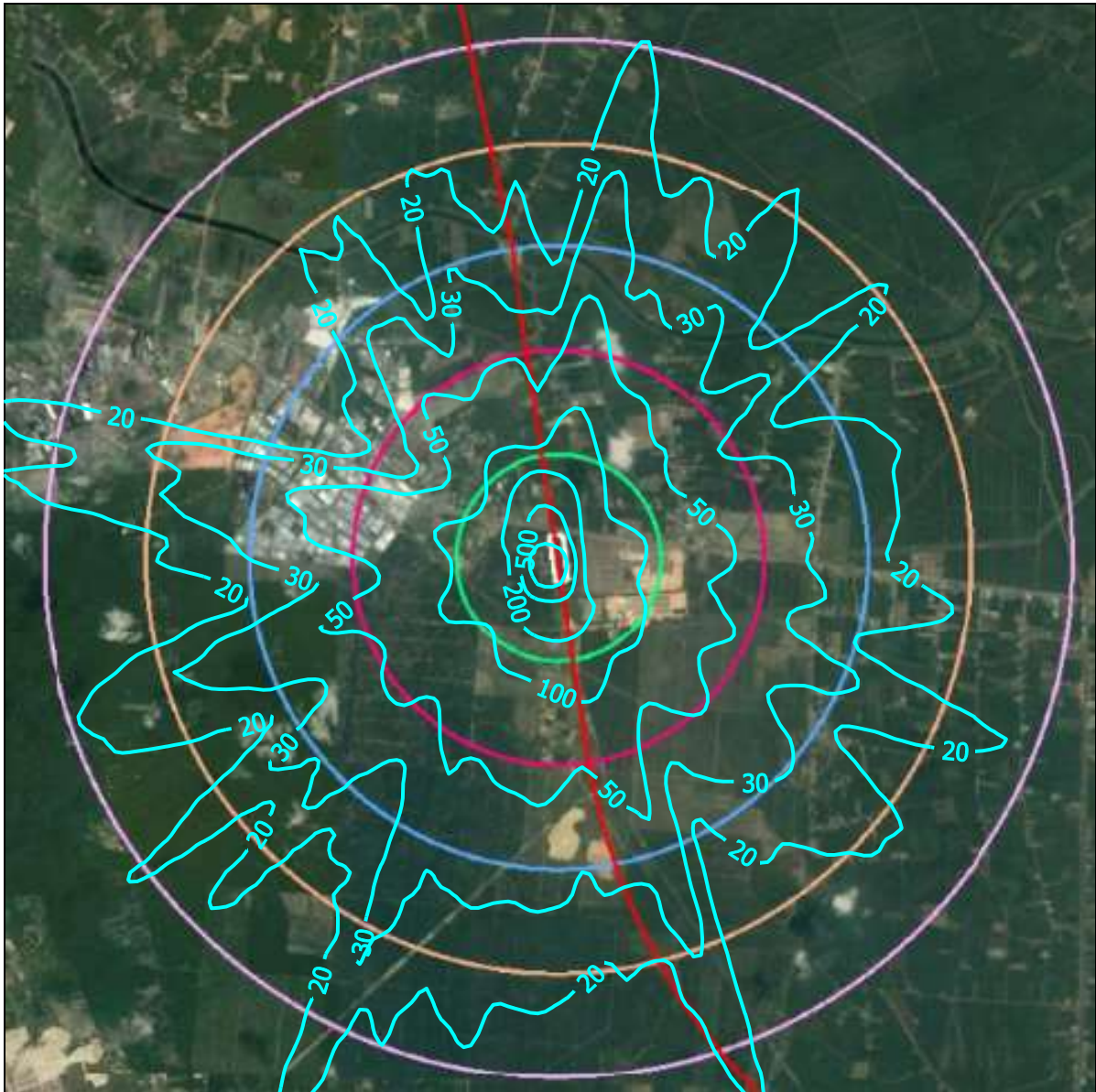


Figure 7-31: Maximum 24-hour Average PM₁₀ Incremental Concentration (µg/m³)
Without Control Measures: Batu Pahat Station

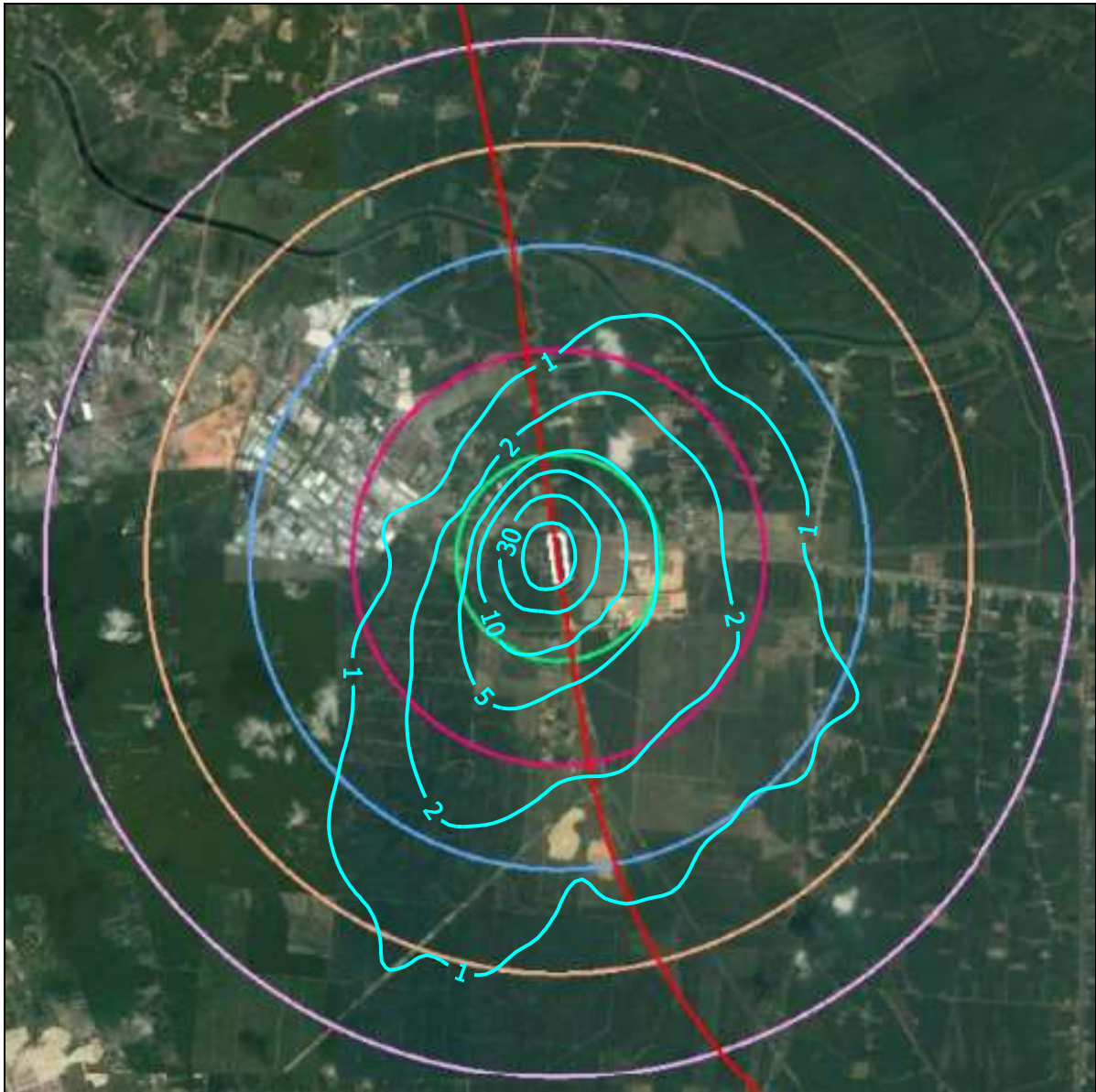


Figure 7-32: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
Without Control Measures: Batu Pahat Station

Iskandar Puteri Station

Although the Iskandar Puteri Station Site area is larger relative to the intermediate Stations, the predicted PM₁₀ concentrations that will be imposed on surrounding areas resulting from construction activities conducted at this Station site will not raise the ambient PM₁₀ concentrations in surrounding areas above the MAAQG limits; but on the condition that dust control measures are adopted. Contours of the predicted maximum 24-hour average and annual average PM₁₀ incremental concentrations are shown in **Figure 7-33 and 7-34** respectively. Without dust control measures being adopted, the surrounding 24 hour PM₁₀ cumulative concentrations will exceed the MAAQG limits at areas up to approximately 2 km from the project site as shown in **Figure 7-35**; and up to approximately 500 m in the case of annual average concentrations as shown in **Figure 7-36**.

The predicted PM₁₀ incremental concentrations, expressed in units of µg/m³, at the identified sensitive and discrete receptors located within a 5 km radius of the Iskandar Puteri Terminus site, for both the with control and without control measures scenarios, are tabulated below;

i) With Control Measures

| Receptor | Existing baseline (µg/m ³) | Incremental concentration (µg/m ³) | | Ambient air concentration (µg/m ³) | |
|------------------------------|--|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Iskandar Puteri Station, A36 | 57 | 58.0 | 7.9 | 115.0 | - |
| Sultan Abu Bakar CIQ, A37 | 40 | 0.3 | 0.1 | 40.3 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

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ii) Without Control Measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|------------------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Iskandar Puteri Station, A36 | 57 | 2,901 | 392.8 | 2,958 | - |
| Sultan Abu Bakar CIQ, A37 | 40 | 15.1 | 0.8 | 55.1 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

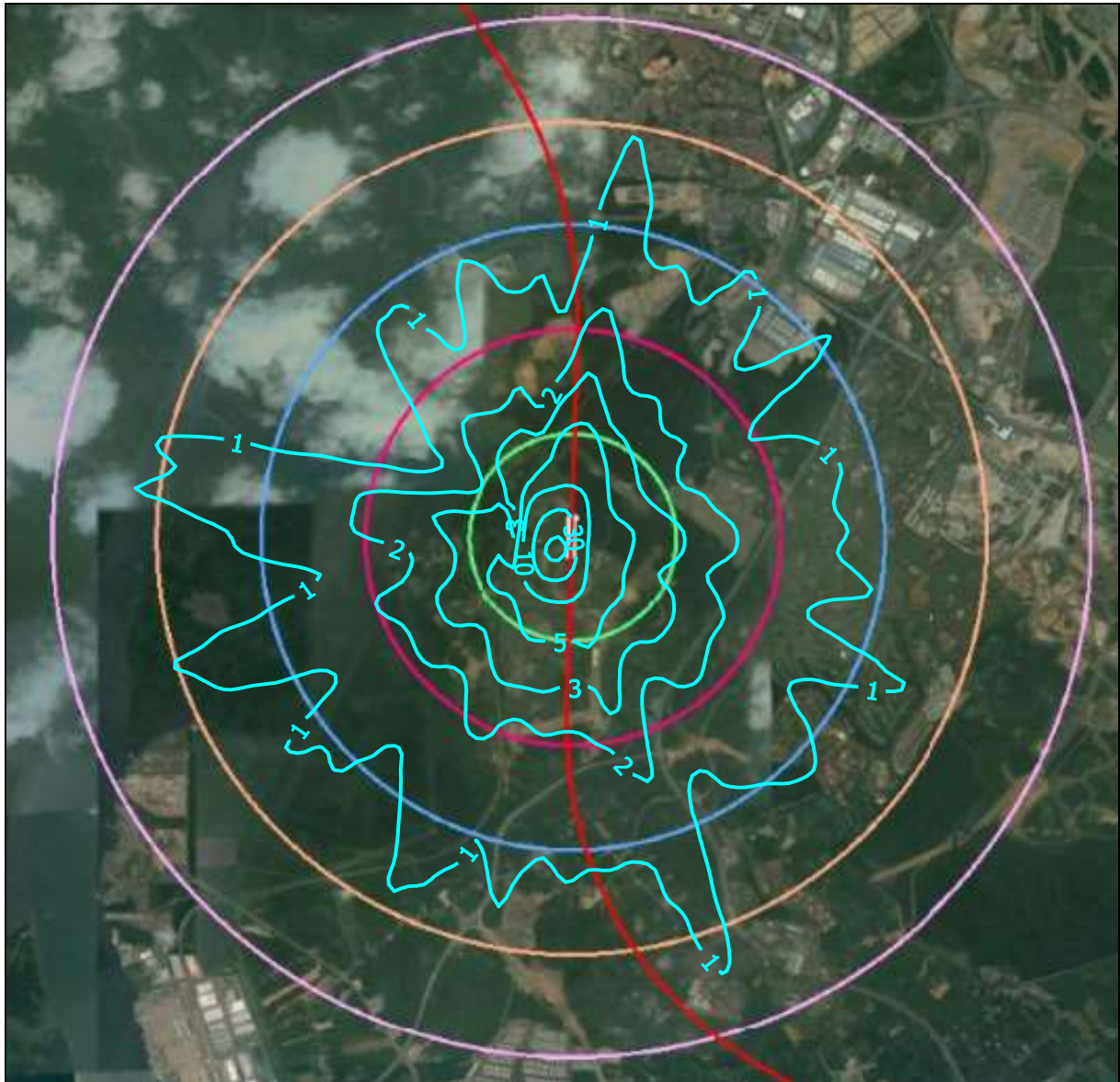


Figure 7-33: Maximum 24-hour Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Iskandar Puteri Station

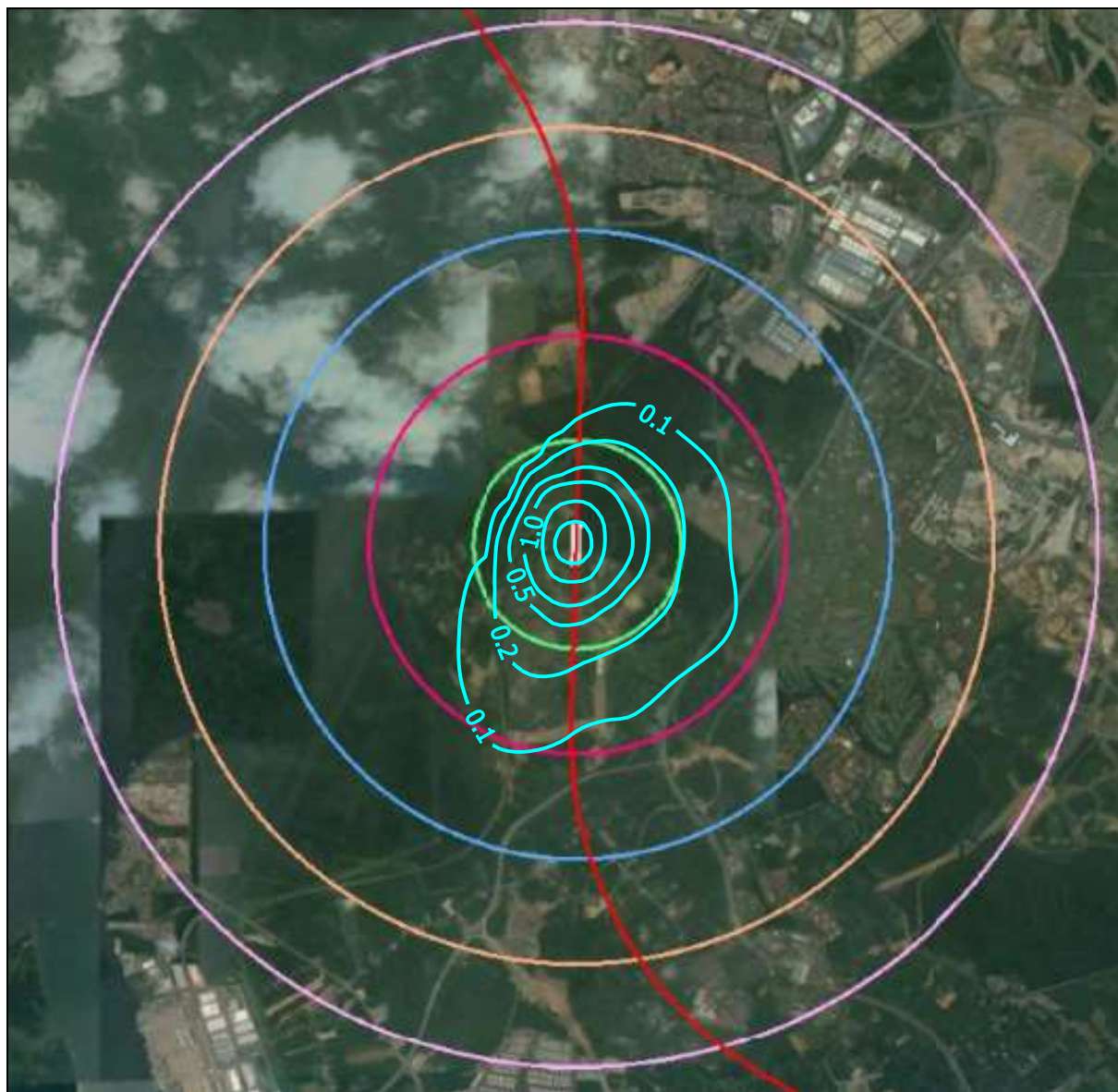


Figure 7-34: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Iskandar Puteri Station

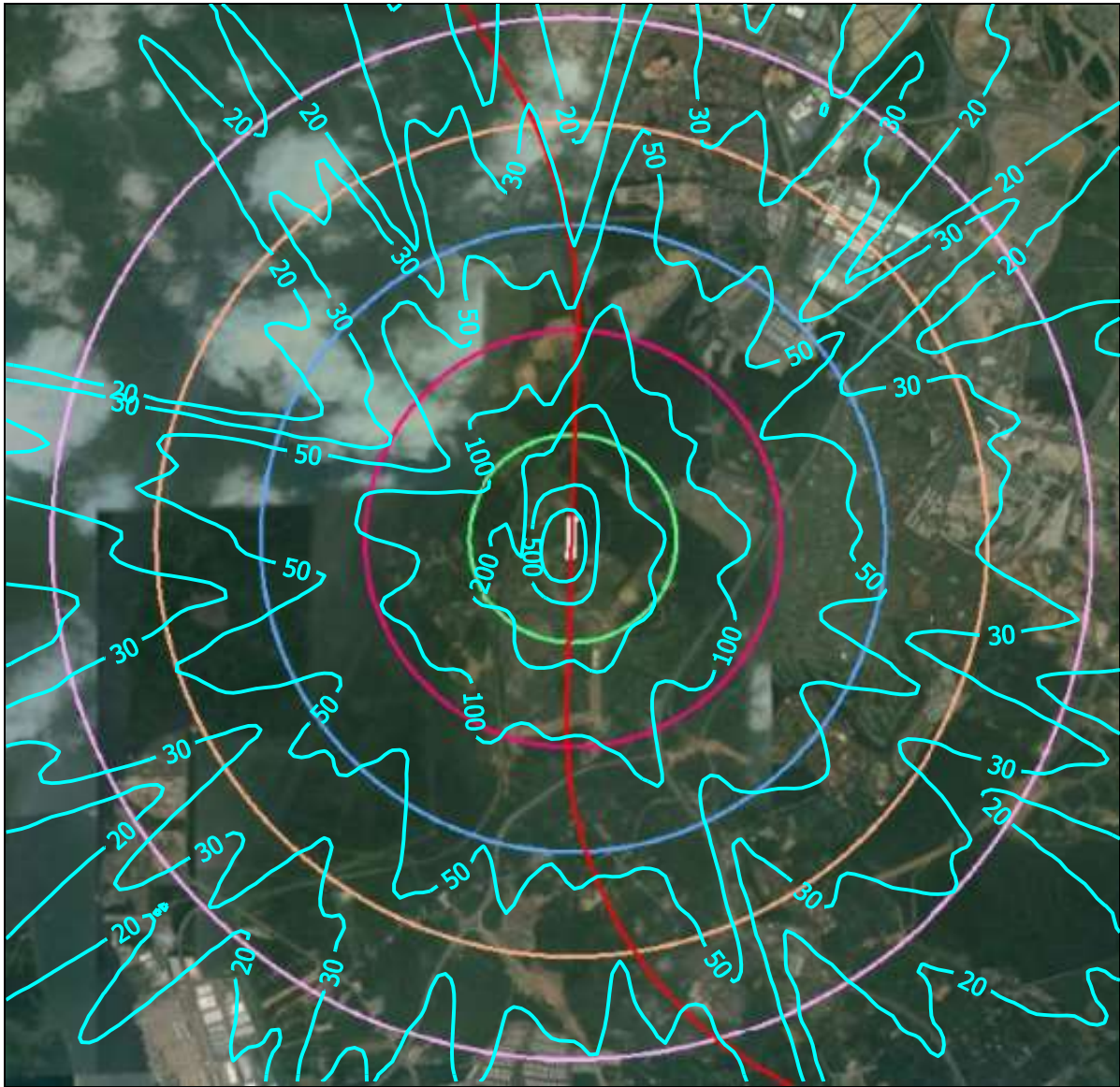


Figure 7-35: Maximum 24-hour Average PM₁₀ Incremental Concentration (µg/m³)
Without Control Measures: Iskandar Puteri Station

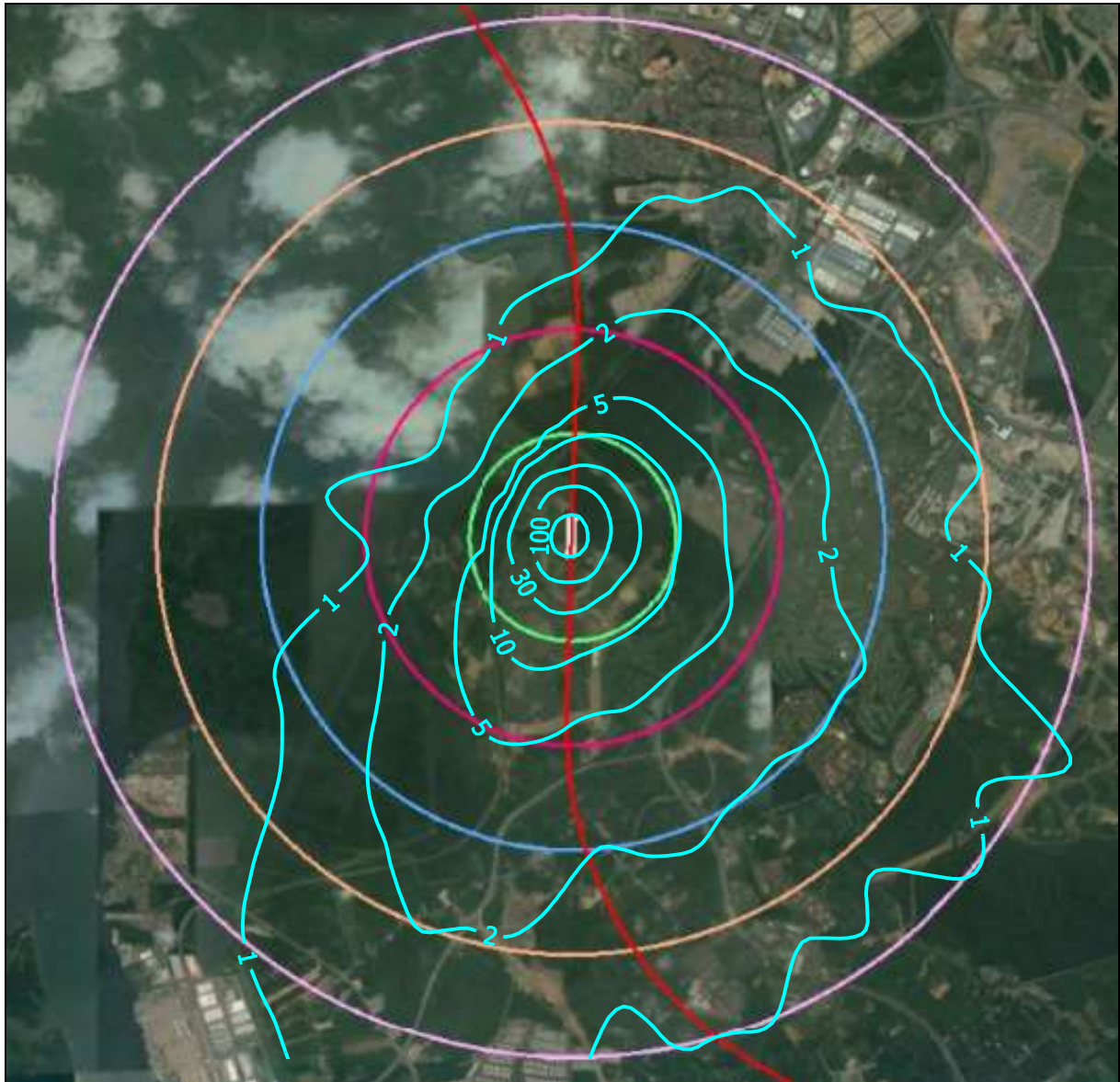


Figure 7-36: Annual Average PM₁₀ Incremental Concentration (µg/m³)
Without Control Measures: Iskandar Puteri Station

Main Depot and Light Maintenance Base, Pontian

The site area identified for the Main Depot and Light Maintenance Base is the largest amongst all HSR facilities. As such it can be assumed that dust dispersions from the construction of this facility will impact on a greater scale on surrounding receptors than that predicted for the other facilities. However, with dust control measures being adopted during construction, and if construction of this facility is carried out in stages, the predicted PM₁₀ concentrations imposed on the surrounding areas will not raise the ambient concentration of

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this pollutant beyond the stipulated MAAQG limits for the maximum 24-hour average and annual average PM₁₀ concentrations. The imposed 24-hour average PM₁₀ concentrations will vary between 1 µg/m³ (at the northeast and northwest edge of the receptor grid) and 50 µg/m³ at the project boundary (**Figure 7-37**). As for the annual average PM₁₀ concentrations, the induced PM₁₀ levels will be between 0.1 µg/m³ at the southern edge of the receptor grid and 1.0 µg/m³ at the project boundary as shown in **Figure 7-38**. Without dust control measures being instituted the predicted 24-hour average PM₁₀ concentrations imposed on surrounding areas will elevate ambient concentrations of the same pollutant well above the MAAQG limits. Predicted annual average PM₁₀ concentrations imposed in areas south of the project site will raise the ambient PM₁₀ levels above the MAAQG limits as shown in **Figures 7-39** and **7-40** respectively.

The predicted PM₁₀ incremental concentrations, expressed in units of µg/m³, at the identified sensitive and discrete receptors within a 5 km radius of the Main Depot and Light Maintenance Base, Pontian for both the with control and without control measures scenarios are tabulated below;

i) With Control Measures

| Receptor | Existing baseline (µg/m ³) | Incremental concentration (µg/m ³) | | Ambient air concentration (µg/m ³) | |
|---------------------------------|--|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Main Depot and LMB, A33 | 42 | 7.7 | 0.1 | 49.7 | - |
| Sekolah Kebangsaan Batu 24, A34 | 43 | 39.4 | 1.5 | 82.4 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

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ii) Without Control Measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|---------------------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Main Depot and LMB, A33 | 42 | 387.2 | 1.0 | 427.2 | - |
| Sekolah Kebangsaan Batu 24, A34 | 43 | 1,976.1 | 73.8 | 2,019.1 | - |
| MAAQG 2020 Target | | | | 100 | 40 |

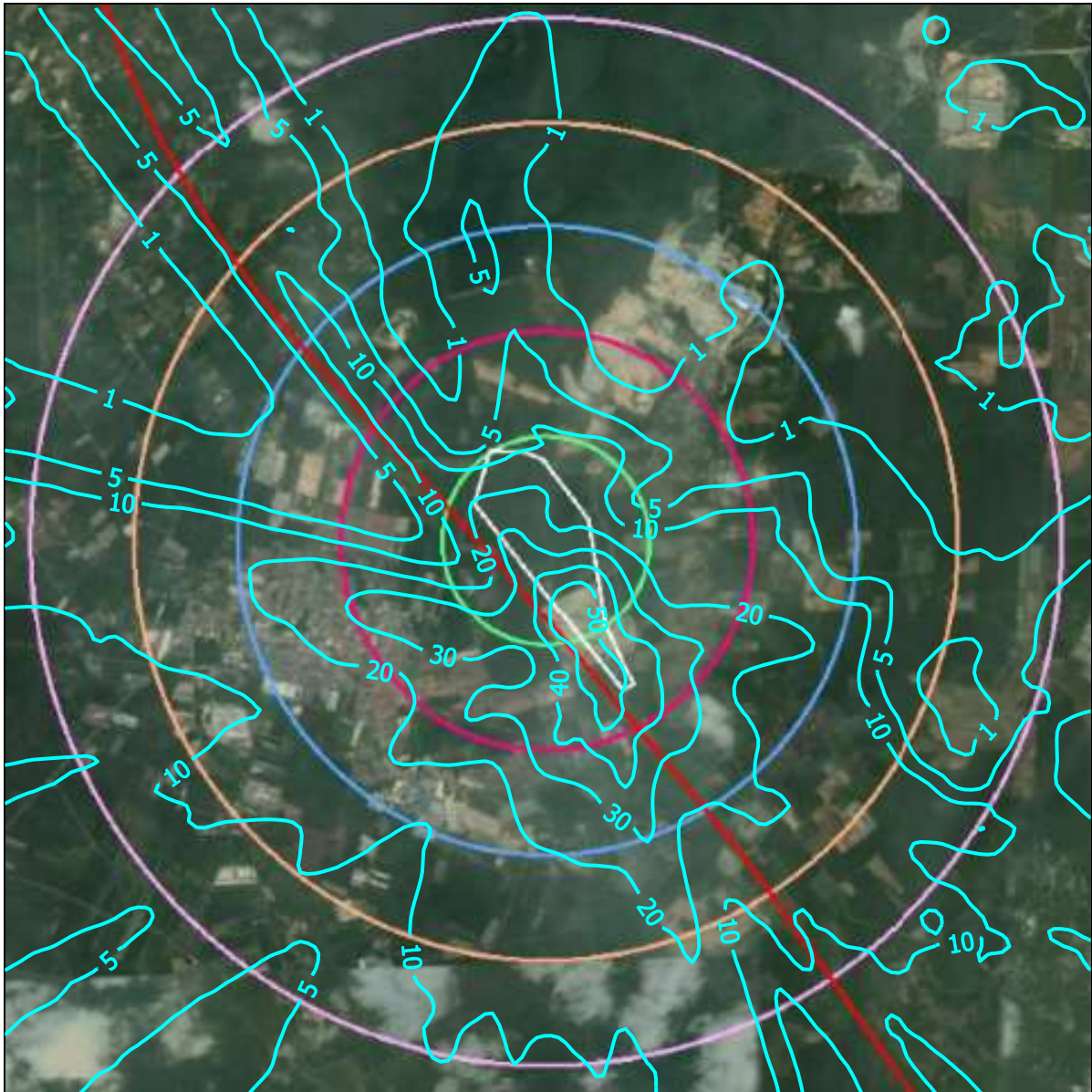


Figure 7-37: Maximum 24-hour Average PM₁₀ Incremental Concentration (µg/m³)
With Control Measures: Main Depot and Light Maintenance Base

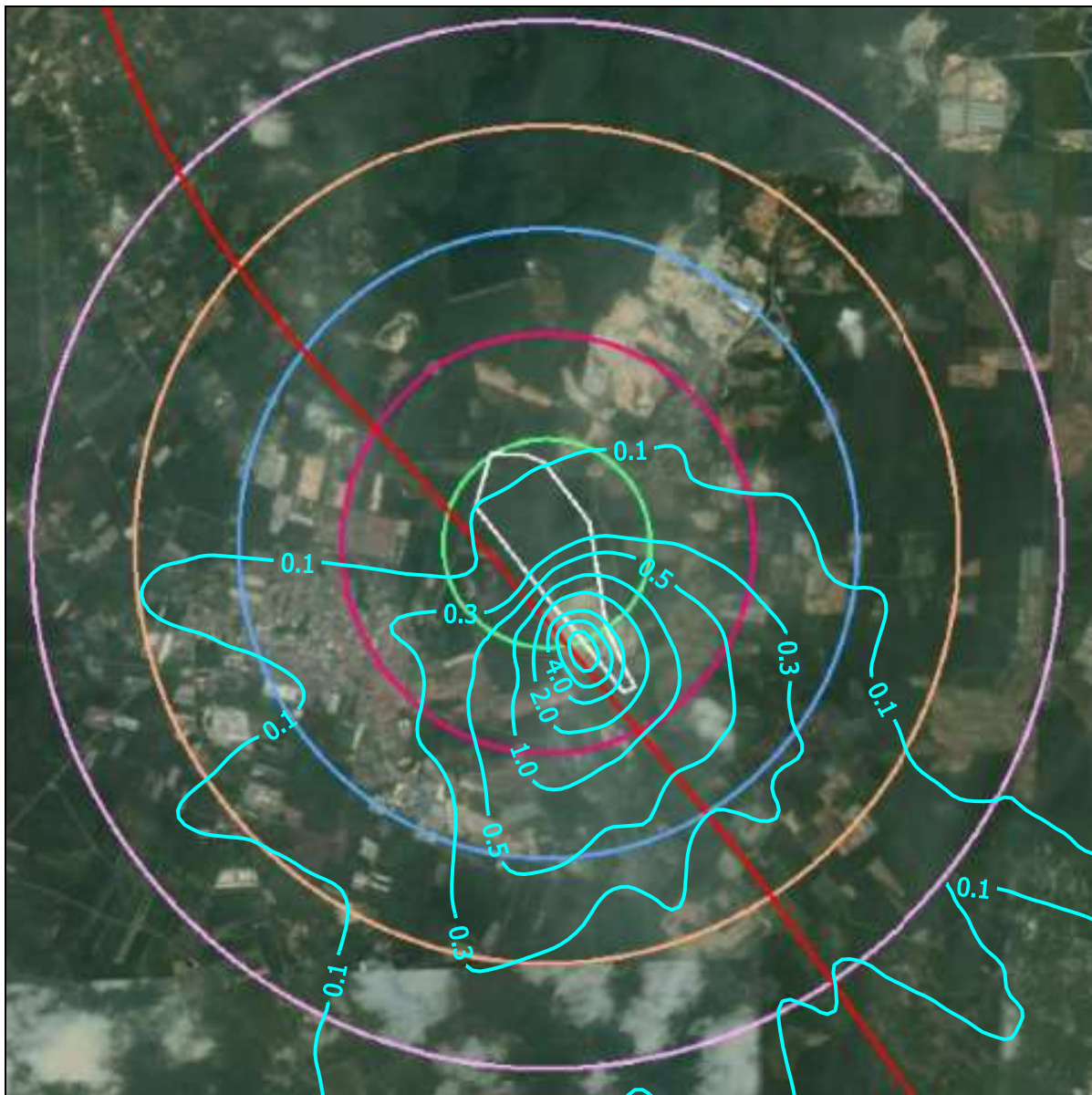


Figure 7-38: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Control Measures: Main Depot and Light Maintenance Base

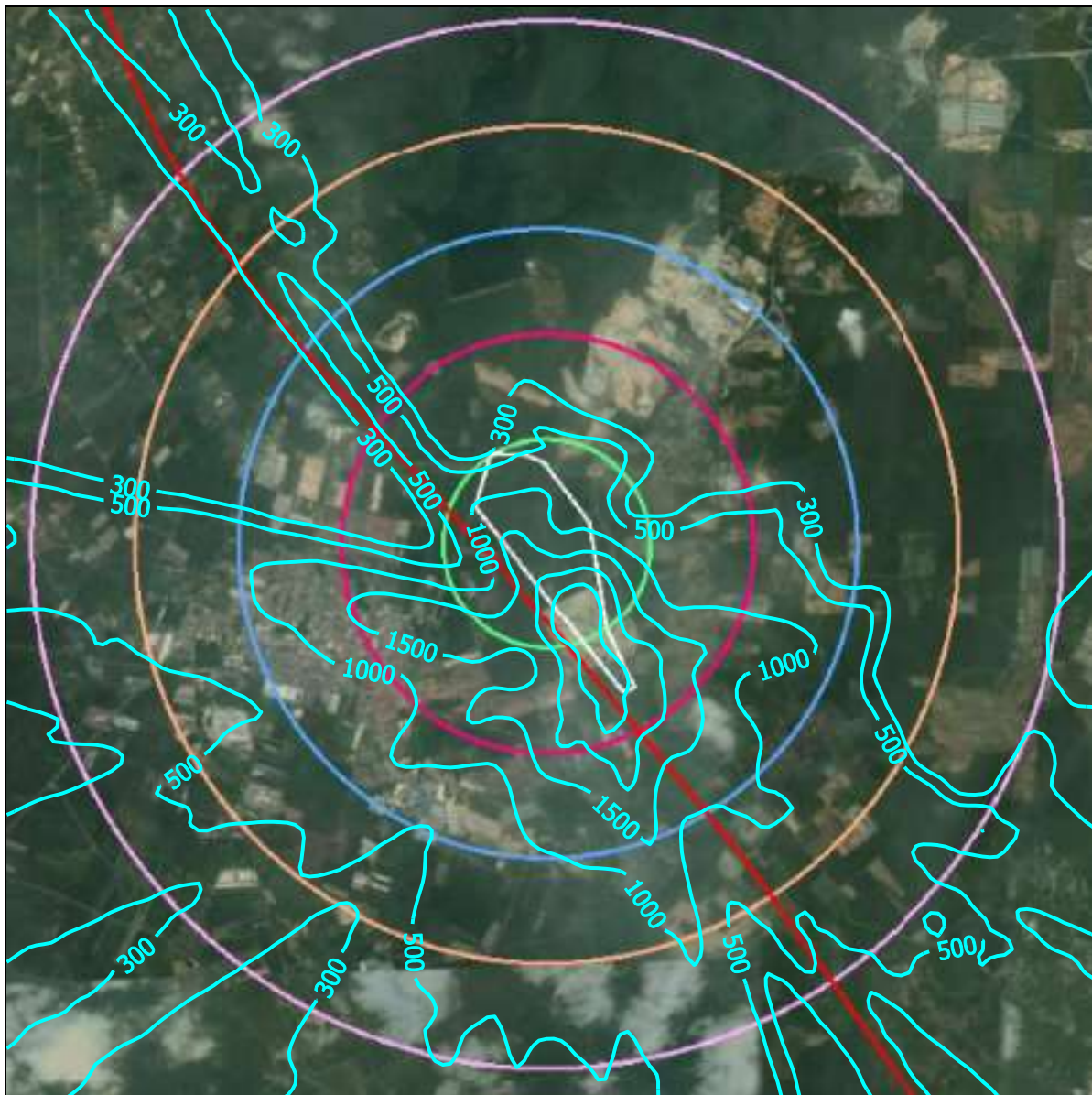


Figure 7-39: Maximum 24-hour Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
Without Control Measures: Main Depot and Light Maintenance Base

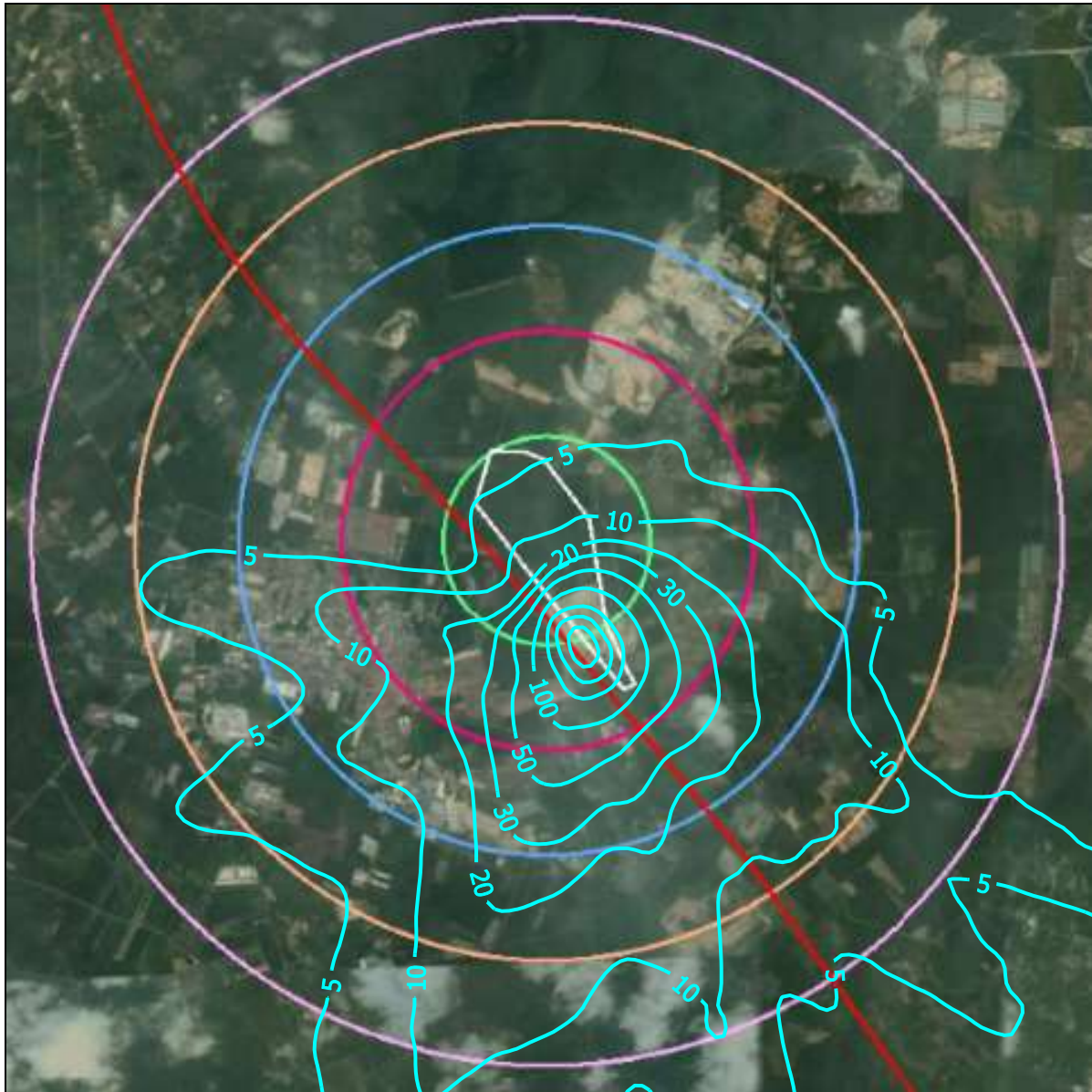


Figure 7-40: Annual Average PM₁₀ Incremental Concentration ($\mu\text{g}/\text{m}^3$)
Without Control Measures: Main Depot and Light Maintenance Base

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HSR Alignment, Johor

Impacts of construction activities along the HSR alignment in Johor are no different from those in the other sectors. Impacts are minimal when there are dust control measures adopted, and will be moderate when there are no control measures taken. Contours for the maximum 24-hour average and annual average PM₁₀ incremental concentrations are shown in **Appendix 7E**.

The predicted PM₁₀ incremental concentrations, expressed in units of µg/m³, at the identified sensitive and discrete receptors located within a 5 km radius of the HSR alignment, Johor for both the with control and without control measures scenarios are tabulated below;

i) With Control Measures

| Receptor | Existing baseline (µg/m ³) | Incremental concentration (µg/m ³) | | Ambient air concentration (µg/m ³) | |
|---------------------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Paya Buloh, A23 | 38 | 2.9 | 0.4 | 40.9 | - |
| Kg. Parit Zing, A24 | 45 | 2.3 | 0.2 | 47.3 | - |
| Kg. Paya Redan, A27 | 26 | 12.4 | 2.9 | 38.4 | - |
| Jalan Parit Botak, A30 | 31 | 2.1 | 0.1 | 33.1 | - |
| SMK Dato Ismail, Majid, A31 | 28 | 2.9 | 0.5 | 30.9 | - |
| Kg. Melayu Raya, A32 | 47 | 1.2 | 0.1 | 48.2 | - |
| Main Depot and LMB, A33 | 42 | 2.2 | 0.1 | 44.2 | - |
| Sekolah Kebangsaan Batu 24, A34 | 43 | 2.1 | 0.1 | 45.1 | - |
| Gelang Patah, A35 | 52 | 2.9 | 0.5 | 54.9 | - |
| Kg. Serom 4 | - | 5.23 | 1.12 | - | - |

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| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|---|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Masjid Kg. Jawa | - | 1.37 | 0.03 | - | - |
| Majid Jamek Sultan Alauddin Riayat Shah 1 | - | 2.91 | 0.65 | - | - |
| Surau Nur Hidayah Kg Bukit Panjang | - | 6.22 | 1.39 | - | - |
| Masjid Felcra Seri Wangi | - | 3.29 | 0.76 | - | - |
| SK Seri Bengkal | - | 7.07 | 1.70 | - | - |
| SMK Dato Ismail Majid | - | 5.88 | 1.29 | - | - |
| Pines Residence | - | 2.56 | 0.22 | - | - |
| SK Tanjung Kupang | - | 8.98 | 2.63 | - | - |
| Masjid Simpang Arang | - | 4.60 | 0.99 | - | - |
| Kg. Ayer Putih | - | 8.07 | 2.34 | - | - |
| Cemetery - Perpetual Memorial Park | - | 2.00 | 0.10 | - | - |
| MAAQG 2020 Target | | | | 100 | 40 |

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ii) Without Control Measures

| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|---|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| Paya Buloh, A23 | 38 | 141.3 | 19.9 | 179.3 | - |
| Kg. Parit Zing, A24 | 45 | 112.7 | 7.9 | 157.7 | - |
| Kg. Paya Redan, A27 | 26 | 610.1 | 1437 | 636.1 | - |
| Jalan Parit Botak, A30 | 31 | 104.1 | 6.6 | 135.1 | - |
| SMK Dato Ismail, Majid, A31 | 28 | 144.2 | 26.0 | 172.2 | - |
| Kg. Melayu Raya, A32 | 47 | 57.0 | 1.0 | 104.0 | - |
| MainDepot and LMB, A33 | 42 | 106.4 | 7.1 | 148.4 | - |
| Sekolah Kebangsaan Batu 24, A34 | 43 | 102.3 | 6.1 | 145.3 | - |
| Gelang Patah, A35 | 52 | 143.1 | 22.5 | 195.1 | - |
| Kg. Serom 4 | - | 257.62 | 55.34 | - | - |
| Masjid Kg. Jawa | - | 67.67 | 1.51 | - | - |
| Majid Jamek Sultan Alauddin Riayat Shah 1 | - | 143.49 | 31.79 | - | - |
| Surau Nur Hidayah Kg Bukit Panjang | - | 306.52 | 68.51 | - | - |
| Masjid Felcra Seri Wangi | - | 162.19 | 37.61 | - | - |
| SK Seri Bengkal | - | 348.57 | 83.97 | - | - |
| SMK Dato Ismail Majid | - | 289.90 | 63.60 | - | - |
| Pines Residence | - | 126.18 | 10.95 | - | - |

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| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|------------------------------------|---|--|----------------|--|----------------|
| | | 24-hour average | Annual average | 24-hour average | Annual average |
| SK Tanjung Kupang | - | 442.47 | 129.38 | - | - |
| Masjid Simpang Arang | - | 226.88 | 48.83 | - | - |
| Kg. Ayer Putih | - | 397.80 | 115.53 | - | - |
| Cemetery - Perpetual Memorial Park | - | 98.36 | 5.11 | - | - |
| MAAQG 2020 Target | | | | 100 | 40 |

Dust as particulate matter PM_{10} is the main air pollutant emitted during the construction phase of the HSR Project. Assessment of the impacts of PM_{10} emissions was conducted using the USEPA AERMOD Model for all the facilities of the project. Modeling results showed that predicted ambient air PM_{10} concentrations are below the new 2013 Malaysian Ambient Air Quality Guidelines (MAAQG) limits when there are control measures adopted to reduce dust emissions at all constructions sites. However when there are no dust control measures taken, predicted PM_{10} concentrations in ambient air are higher and is above the MAAQG limits. Depending on the size of the construction area, the MAAQG limits are exceeded in areas up to 500 m to 3,000 m from the construction site when there are no dust control measures taken. Thus dust control measures are mandatory during the construction phase of the project especially when construction activities are intense and during prolonged dry weather. As the construction phase is a temporary and transient activity, the impact of dust emissions is expected to be short term.

A summary of the predicted PM_{10} concentrations at the selected sensitive and discrete receptors throughout the HSR Project for with and without dust control measures is provided in **Table 7-2**.

Other criteria pollutants, carbon monoxide, sulphur dioxide and nitrogen dioxide are not assessed because the amount emitted is insignificant.

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Table 7-2: Summary of Predicted PM₁₀ Concentration (µg/m³) at Sensitive and Discrete Receptors.

| Receptor | Existing baseline (µg/m³) | Construction Activity | Incremental concentration (µg/m³) | | Ambient air concentration (µg/m³) | |
|---|---------------------------|--------------------------|-----------------------------------|----------------|-----------------------------------|----------------|
| | | | 24-hour average | Annual average | 24-hour average | Annual average |
| With control measures | | | | | | |
| Bandar Malaysia Terminal, A1 | 35 | Bandar Malaysia Station | 21.6 | 3.4 | 56.6 | - |
| Bandar Sri Permaisuri, A2 | 41 | Bandar Malaysia Station | 1.0 | 0.1 | 42.0 | - |
| Taman Serdang Pertama, A3 | 37 | Alignment | 1.7 | 0.2 | 38.7 | - |
| Seri Kembangan Medical Clinic, A4 (alignment) | 40 | Alignment | 6.5 | 1.5 | 46.5 | - |
| Seri Kembangan Medical Clinic, A4 | 40 | Light Depot and LMB | 0.4 | 0.1 | 40.4 | - |
| MyHSR North Depot, A5 | 20 | Light depot and LMB | 9.2 | 0.2 | 29.2 | - |
| Putrajaya Diplomatic Precinct, A6 | 23 | Light Depot and LMB | 0.4 | 0.1 | 23.4 | - |
| Putrajaya Diplomatic Precinct, A6 | 23 | Sepang-Putrajaya Station | 2.4 | 0.2 | 25.4 | - |
| Sekolah Menengah Teknik Sepang, A7 | 26 | Alignment | 0.8 | 0.1 | 26.8 | - |
| Taman Desa Bestari, A8 | 26 | Alignment | 0.9 | 0.1 | 26.9 | - |
| KPJ Healthcare University, A9 | 34 | Alignment | 2.7 | 0.5 | 36.7 | - |
| Kg. Jijan Hulu, A10 | 40 | Alignment | 0.5 | 0.1 | 40.5 | - |
| Kg. Jijan Hulu, A10 | 40 | Seremban Station | 0.1 | 0.1 | 40.1 | - |
| MPOB POMTEC, Labu, A11 | 41 | Seremban Station | 0.2 | 0.1 | 41.2 | - |

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| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Construction Activity | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|--|---|-----------------------|---|----------------|---|----------------|
| | | | 24-hour average | Annual average | 24-hour average | Annual average |
| Taman Cermat Impian, A12 | 28 | Seremban Station | 0.3 | 0.1 | 28.3 | - |
| Kg Sendayan, A13 | 30 | Alignment | 1.1 | 0.1 | 31.1 | - |
| Taman Sungai Ujong, A14 | 27 | Alignment | 1.3 | 0.1 | 28.3 | - |
| Taman Seri Aman, A15 | 45 | Alignment | 0.8 | 0.1 | 45.8 | - |
| Kg. Solok Air Limau, A16 | 41 | Alignment | 1.9 | 0.1 | 42.9 | - |
| Kg. Durian Daun, A17 | 49 | Alignment | 4.6 | 1.4 | 53.6 | - |
| 1 Krubong Residence, A18 | 56 | Alignment | 2.0 | 0.1 | 58.0 | - |
| Cempaka Heights, A19 | 40 | Melaka Station | 1.3 | 0.1 | 41.3 | - |
| Taman Bemban Baru, A20 | 57 | Alignment | 4.5 | 1.0 | 61.5 | - |
| Open space / palm oil plantation, A21, | 28 | Alignment | 1.9 | 0.1 | 29.9 | - |
| Kg. Seri Mendapat, A22 | 44 | Alignment | 1.3 | 0.1 | 45.3 | - |
| Paya Buloh, A23 | 38 | Alignment | 2.9 | 0.4 | 40.9 | - |
| Kg. Parit Zing, A24 | 45 | Alignment | 2.3 | 0.2 | 47.3 | - |
| Kg. Jawa Panchor, A25 | 27 | Muar Station | 0.6 | 0.1 | 27.6 | - |
| Kg. Jawa Panchor, A25 | 27 | HMB | 7.2 | 0.1 | 34.2 | - |
| Muar Station, A26 | 20 | Muar Station | 9.2 | 1.7 | 29.2 | - |
| Muar Station, A26 | 20 | HMB | 11.3 | 0.1 | 31.3 | - |

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| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Construction Activity | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|---------------------------------------|---|-------------------------|---|----------------|---|----------------|
| | | | 24-hour average | Annual average | 24-hour average | Annual average |
| Kg. Paya Redan, A27 | 26 | Alignment | 12.4 | 2.9 | 38.4 | - |
| Kawasan Perindustrian Sri Gading, A28 | 54 | Batu Pahat Station | 0.8 | 0.1 | 54.8 | - |
| Batu Pahat Station, A29 | 44 | Batu Pahat Station | 5.8 | 0.4 | 49.8 | - |
| Jalan Parit Botak, A30 | 31 | Alignment | 2.1 | 0.1 | 33.1 | - |
| SMK Dato Ismail, Majid, A31 | 28 | Alignment | 2.9 | 0.5 | 30.9 | - |
| Kg. Melayu Raya, A32 | 47 | Alignment | 1.2 | 0.1 | 48.2 | - |
| South Depot, A33 | 42 | Main Depot and LMB | 7.7 | 0.1 | 49.7 | - |
| Sekolah Kebangsaan Batu 24, A34 | 43 | Main Depot and LMB | 39.4 | 1.5 | 82.4 | - |
| Sekolah Kebangsaan Batu 24, A34 | 43 | Alignment | 2.1 | 0.1 | 45.1 | |
| Gelang Patah, A35 | 52 | Alignment | 2.9 | 0.5 | 54.9 | - |
| Iskandar Puteri Station, A36 | 57 | Iskandar Puteri Station | 58.0 | 7.9 | 115.0 | - |
| Sultan Abu Bakar CIQ, A37 | 40 | Iskandar Puteri Station | 0.3 | 0.1 | 40.3 | - |
| MAAQG 2020 Target | | | | | 100 | 40 |
| Without control measures | | | | | | |
| Bandar Malaysia Terminal, A1 | 35 | Bandar Malaysia Station | 1,079 | 172 | 1,104 | - |

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| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Construction Activity | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|---|---|--------------------------|---|----------------|---|----------------|
| | | | 24-hour average | Annual average | 24-hour average | Annual average |
| Bandar Sri Permaisuri, A2 | 41 | Bandar Malaysia Station | 48 | 3 | 89 | - |
| Taman Serdang Pertama, A3 | 37 | Alignment | 83.2 | 11.8 | 120.2 | - |
| Seri Kembangan Medical Clinic, A4 (alignment) | 40 | Alignment | 321.2 | 74.6 | 361.2 | - |
| Seri Kembangan Medical Clinic, A4 | 40 | Light depot and LMB | 16.4 | 0.4 | 46.4 | - |
| Light Depot and LMB, A5 | 20 | Light depot and LMB | 417.1 | 12.3 | 437.1 | - |
| Putrajaya Diplomatic Precinct, A6 | 23 | Lightdepot and LMB | 20.1 | 0.5 | 43.1 | - |
| Putrajaya Diplomatic Precinct, A6 | 23 | Sepang-Putrajaya Station | 121.7 | 7.6 | 144.7 | - |
| Sekolah Menengah Teknik Sepang, A7 | 26 | Alignment | 39.7 | 2.4 | 65.7 | - |
| Taman Desa Bestari, A8 | 26 | Alignment | 43.8 | 2.6 | 69.8 | - |
| KPJ Healthcare University, A9 | 34 | Alignment | 133.4 | 27.1 | 167.4 | - |
| Kg. Jijan Hulu, A10 | 40 | Alignment | 22.8 | 0.9 | 62.8 | - |
| Kg. Jijan Hulu, A10 | 40 | Seremban Station | 4.6 | 0.1 | 44.6 | - |
| MPOB POMTEC, Labu, A11 | 41 | Seremban Station | 12.1 | 0.2 | 53.1 | - |
| Taman Cernai Impian, A12 | 28 | Seremban Station | 14.9 | 0.5 | 42.9 | - |

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| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Construction Activity | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|--|---|------------------------|---|----------------|---|----------------|
| | | | 24-hour average | Annual average | 24-hour average | Annual average |
| Kg. Sendayan, A13 | 30 | Alignment | 53.9 | 4.1 | 83.9 | - |
| Taman Sungai Ujung, A14 | 27 | Alignment | 62.4 | 5.7 | 89.4 | - |
| Taman Seri Aman, A15 | 45 | Alignment | 41.6 | 2.4 | 86.6 | - |
| Kg. Solok Air Limau, A16 | 41 | Alignment | 94.3 | 2.6 | 135.3 | - |
| Kg. Durian Daun, A17 | 49 | Alignment | 225.9 | 68.5 | 247.9 | - |
| 1 Krubong Residence, A18 | 56 | Alignment | 96.5 | 2.8 | 152.5 | - |
| Cempaka Heights, A19 | 40 | Melaka Station | 66.1 | 1.2 | 106.1 | - |
| Taman Bemban Baru, A20 | 57 | Alignment | 222.4 | 49.6 | 279.4 | - |
| Open space / palm oil plantation, A21, | 28 | Alignment | 94.2 | 2.6 | 122.2 | - |
| Kg. Seri Mendapat, A22 | 44 | Alignment | 65.6 | 1.0 | 109.6 | - |
| Paya Buloh, A23 | 38 | Alignment | 141.3 | 19.9 | 179.3 | - |
| Kg. Parit Zing, A24 | 45 | Alignment | 112.7 | 7.9 | 157.7 | - |
| Kg. Jawa Panchor, A25 | 27 | Muar Station | 29.9 | 0.3 | 56.9 | - |
| Kg. Jawa Panchor, A25 | 27 | Heavy Maintenance Base | 361.6 | 3.0 | 388.6 | - |

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| Receptor | Existing baseline ($\mu\text{g}/\text{m}^3$) | Construction Activity | Incremental concentration ($\mu\text{g}/\text{m}^3$) | | Ambient air concentration ($\mu\text{g}/\text{m}^3$) | |
|---------------------------------------|---|-------------------------|---|----------------|---|----------------|
| | | | 24-hour average | Annual average | 24-hour average | Annual average |
| Muar Station, A26 | 20 | Muar Station | 459.3 | 82.6 | 479.3 | - |
| Muar Station, A26 | 20 | Heavy Maintenance Base | 567.3 | 5.4 | 577.3 | - |
| Kg. Paya Redan, A27 | 26 | Alignment | 610.1 | 1437 | 636.1 | - |
| Kawasan Perindustrian Sri Gading, A28 | 54 | Batu Pahat Station | 39.8 | 0.7 | 93.8 | - |
| Batu Pahat Station, A29 | 44 | Batu Pahat Station | 289.0 | 21.9 | 333.0 | - |
| Jalan Parit Botak, A30 | 31 | Alignment | 104.1 | 6.6 | 135.1 | - |
| SMK Dato Ismail, Majid, A31 | 28 | Alignment | 144.2 | 26.0 | 172.2 | - |
| Kg. Melayu Raya, A32 | 47 | Alignment | 57.0 | 1.0 | 104.0 | - |
| Main Depot and LMB, A33 | 42 | Main Depot and LMB | 106.4 | 7.1 | 148.4 | - |
| Sekolah Kebangsaan Batu 24, A34 | 43 | Main Depot and LMB | 1,976.1 | 73.8 | 2,019.1 | - |
| Sekolah Kebangsaan Batu 24, A34 | 43 | Alignment | 102.3 | 6.1 | 145.3 | - |
| Gelang Patah, A35 | 52 | Alignment | 143.1 | 22.5 | 195.1 | - |
| Iskandar Puteri Station, A36 | 57 | Iskandar Puteri Station | 2,901 | 392.8 | 2,958 | - |
| Sultan Abu Bakar CIQ, A37 | 40 | Iskandar Puteri Station | 15.1 | 0.8 | 55.1 | - |

7.2.1.3 Construction Access Roads

The predominant activity that is capable of inducing air quality impacts relates to the movement of construction vehicles over access roads leading to construction sites. Generally as access roads are temporary in nature, they are unpaved. Dust emissions occur mainly from the transport of construction material to, and waste from, the project sites. Two (2) scenarios namely, with control and without control measures, were simulated based on this activity. With dust the air pollutant of concern, the applicable parameter in this assessment is PM₁₀.

Predicted Emission Rates

Dust plumes trailing behind vehicles travelling on unpaved roads are a familiar sight in most exposed sites. The quantity of dust emissions from a given segment of unpaved road varies linearly with the traffic volume. Field investigations have also shown that the rate of dust emissions depend on factors that characterize the condition of particular road and associated vehicle traffic. These include average vehicle speed, average vehicle weight, average number of wheels per vehicle, road surface texture, and road surface moisture.

Dust emissions from unpaved roads have been found to vary in direct proportion to the fraction of silt (particles smaller than 75 micrometers in diameter) in the road surface material. The silt content of an unpaved dirt road will vary with location. Unpaved roads have a hard, generally nonporous surface that usually dries quickly after a rainfall. The temporary reduction in emissions caused by precipitation may be accounted for by not considering emissions on "wet" days.

The following empirical expression may be used to estimate the quantity of size-specific particulate emissions from an unpaved road, per vehicle kilometer travelled (VKT) (USEPA, 1995).

$$\text{Emission, } E = k(0.17) [s/12] [S/48] [W/2.7]^{0.7} [w/4]^{0.5} [(365-p)/365] \text{ kg/VKT}$$

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In this case study, the following values were used to compute emissions from unpaved roads:-

k, particulate multiplier = 0.5 for PM₁₀

s, silt content = 20%

S, mean vehicle speed = 15 kmph

W, mean vehicle weight = 15 tons (Mg)

w, mean number of wheels = 6

p, mean number of rain days = 200

Based on the values above, the emission factor is computed to be:-

$$E = 0.5 (0.17) [20/12] [15/48] [15/2.7]^{0.7} [6/4]^{0.5} [(365-200)/365] \text{ kg/VKT}$$

$$E = 0.5 \times 0.17 \times 1.666 \times 0.3125 \times 3.332 \times 1.224 \times 0.452 \text{ kg/VKT}$$

$$E = 0.082 \text{ kg/VKT}$$

For each construction site and an estimated 300 lorry trips per day is expected to transport materials to and from the construction site. Assuming a vehicle weight of 15 tons, the peak emission rate of particulate matter per kilometer travelled is estimated to be 369 kg/day (0.082 X 300 X 1.0 X 15). Assuming that construction activity occur 12 hours in a day the corresponding peak particulate emission rate is calculated to be 30.75 kg/hour (i.e. 369 / 12), or 8.54 g/s (30.75 X 1,000 / (60 X 60)).

With control measures such as keeping the roads wet and moist using water trucks and sprinklers and good housekeeping measures, the amount of dust emitted can easily be reduced significantly. Dust emissions can be reduced by as much as 99 percent. However for modeling purposes, the amount of dust removed is assumed at 95 percent. Thus the emission rate when there are dust control measures is calculated to be 0.427 g/s (8.54 X (100-95) / 100).

Impact Assessment

Air quality impact assessment associated with trucks travelling access roads has been conducted through dispersion modeling employing the universally recognized USEPA AERMOD Model. Data inputs to the model include source information, receptor grid,

sensitive and discrete receptors, meteorology, dispersion options, model output and output parameters.

Output Parameters

The following parameters were predicted;

- i). Maximum 24-hour average PM₁₀ concentration
- ii). Annual average PM₁₀ concentration

for two (2) scenarios, the first when there are control measures to reduce dust emissions and the second, a worst case scenario when there are no control measures.

Results

As mentioned above, two (2) scenarios were simulated to assess the impacts of access road activities on surrounding air quality; i.e. with and without dust control measures being adopted. The worst case scenario is when dust control measures are not adopted.

With dust control measures routinely taken to control emissions generated by motor vehicles on access roads, the predicted maximum 24-hour average PM₁₀ incremental concentration in the receptor grid of 3-km radius area was between a low of 10 µg/m³ at approximately 3 km away in most directions and the highest incremental concentration of 60 µg/m³ at the boundary of the road itself. **Figure 7-41** shows the predicted maximum 24-hour average PM₁₀ incremental concentration contours. With the adoption of dust control measures, the predicted PM₁₀ concentrations in ambient air are expected to fall below the new MAAQG limit of 100 µg/m³. In the case of the annual average PM₁₀ concentration levels, the predicted PM₁₀ incremental concentration is mainly below 5.0 µg/m³ and deemed insignificant and below the new guideline limit of 40 µg/m³. The results of the modelling for this parameter are shown in **Figure 7-42**.

Without any adoption of dust control measures, dust dispersions from the access road will result in induced 24 hour PM₁₀ concentrations that vary between 100 µg/m³ at the edge of the receptor grid and 1,000 µg/m³ at the road boundary. Predicted 24 hour PM₁₀ concentrations will be above the guideline limit of 100 µg/m³ throughout the receptor grid.

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If, in the unlikely event control measures are not practiced over a long period of time, the predicted annual average PM_{10} incremental concentration is expected to range between $3 \mu\text{g}/\text{m}^3$ at a point three km to the south and $200 \mu\text{g}/\text{m}^3$ at the road boundary. The annual average PM_{10} concentration will be above the guideline limit of $40 \mu\text{g}/\text{m}^3$ in areas up to 1 km from the access road. Information derived from the modeling exercise, and portrayed in terms of annual average PM_{10} incremental concentration contours, is presented in **Figure 7-43 and 7-44**.

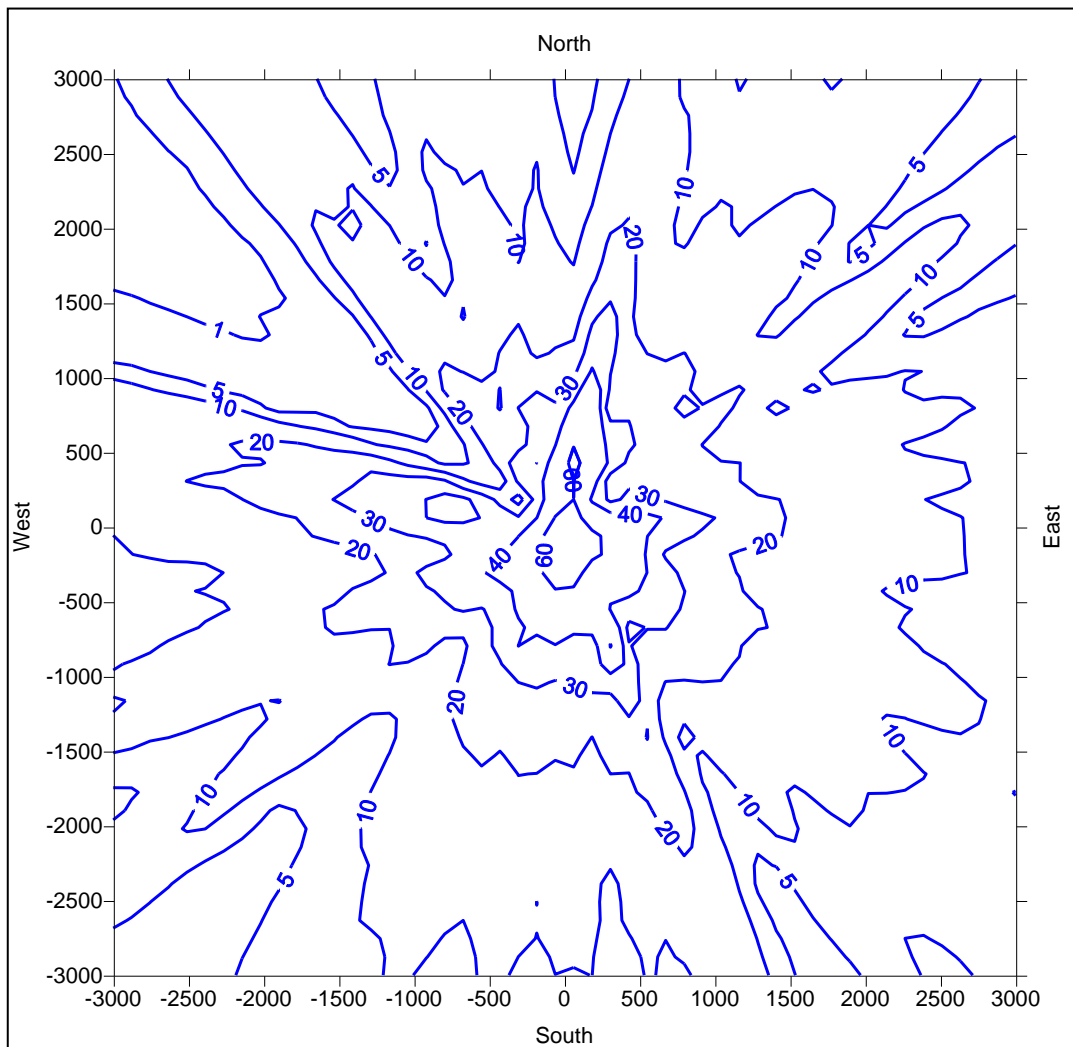


Figure 7-41: Maximum 24-hour Average PM_{10} Incremental Concentration ($\mu\text{g}/\text{m}^3$)
With Dust Control Measures

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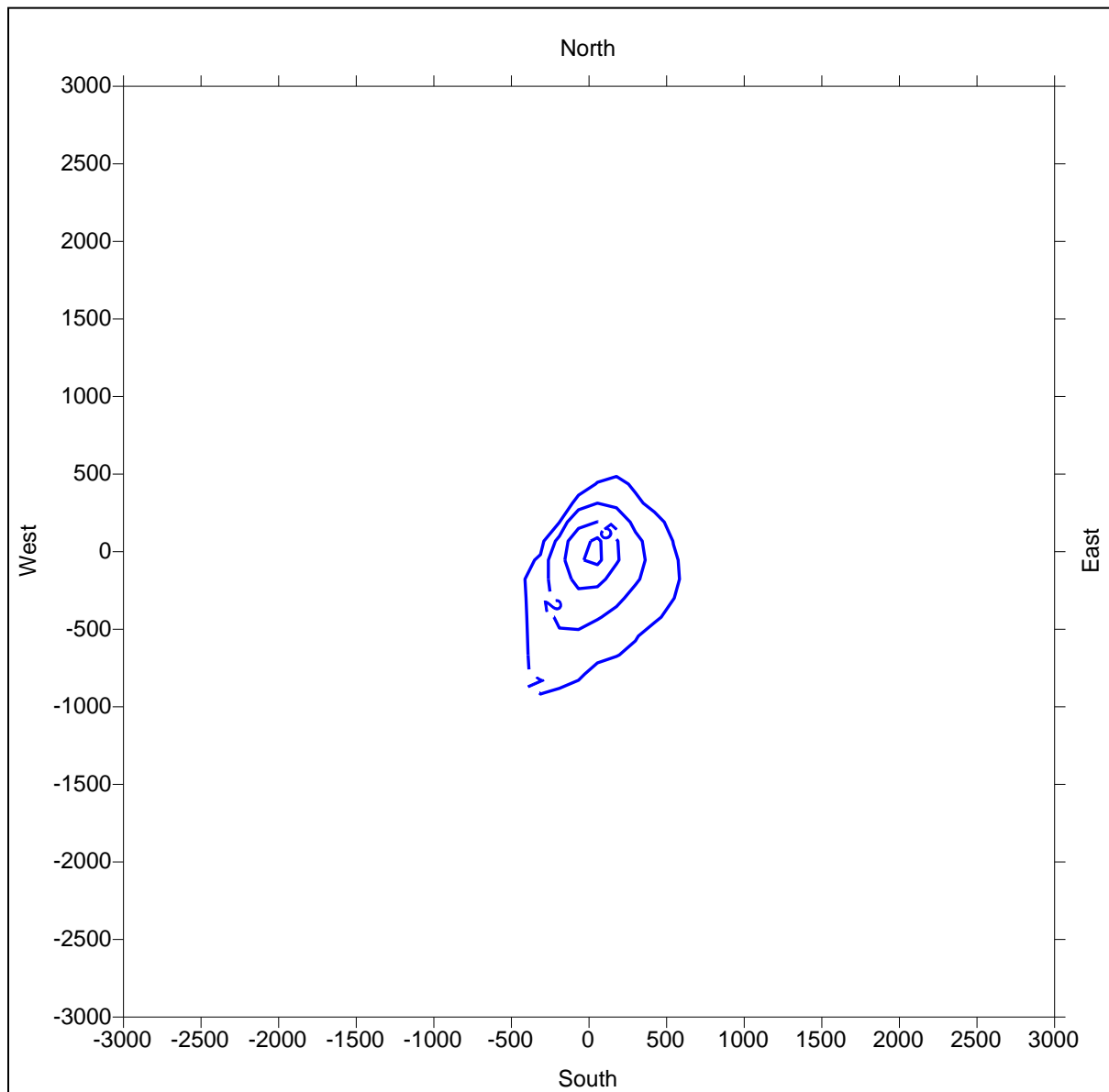


Figure 7-42: Annual Average PM₁₀ Incremental Concentration (µg/m³)
With Dust Control Measures

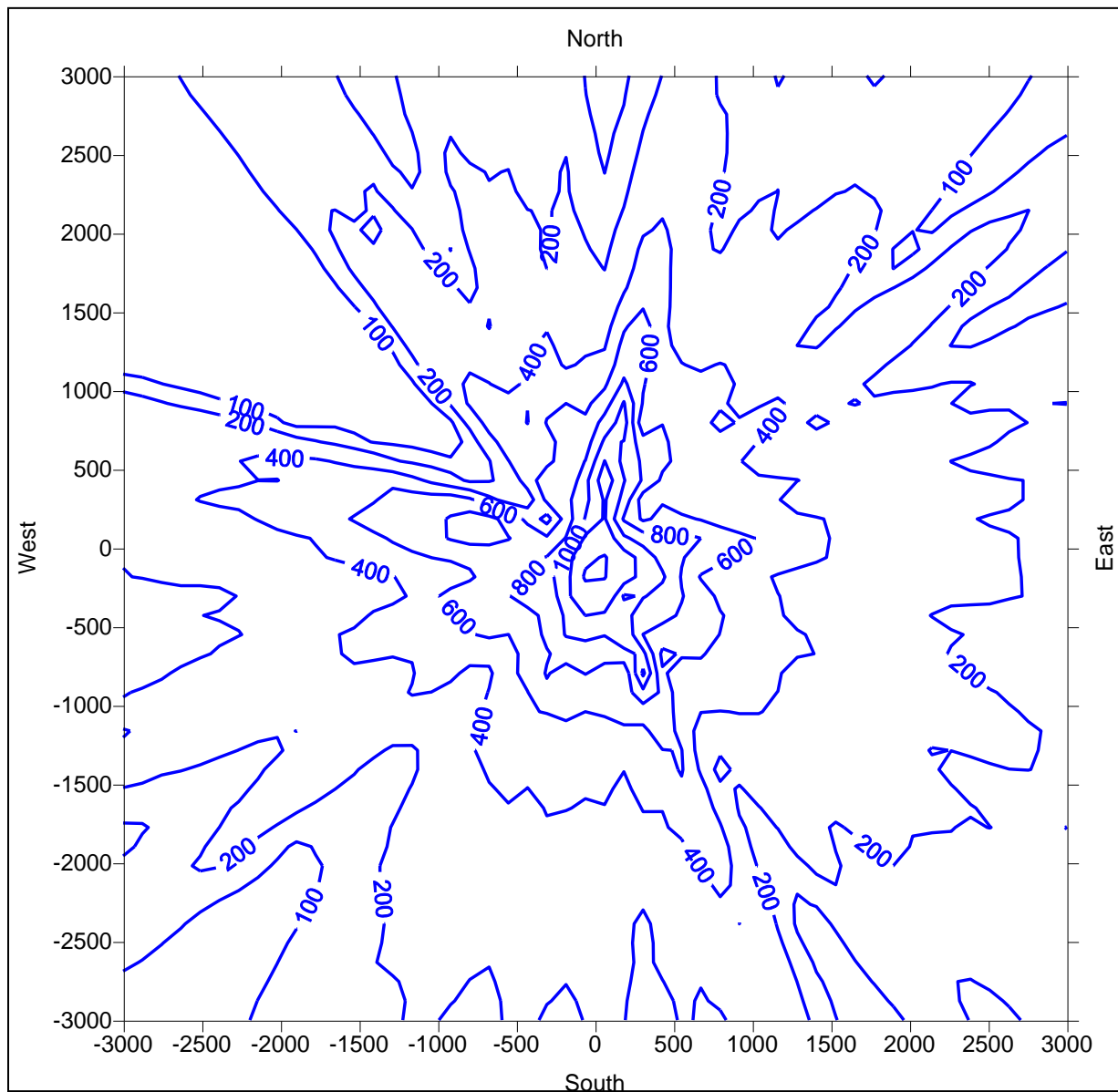


Figure 7-43: Maximum 24-hour Average PM₁₀ Incremental Concentration (µg/m³) Without Dust Control Measures

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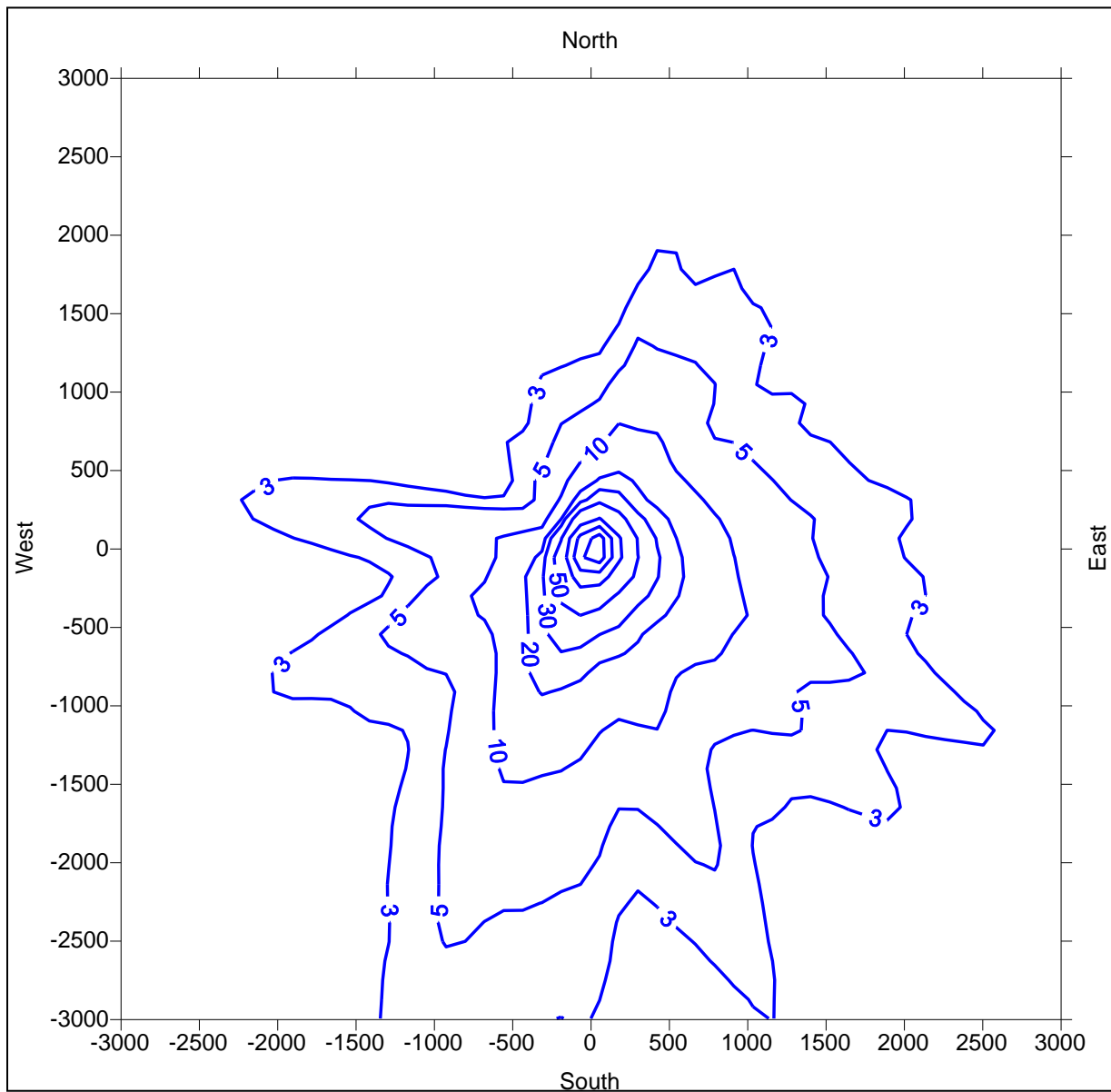


Figure 7-44: Annual Average PM₁₀ Incremental Concentration (µg/m³) Without Dust Control Measures

This modeling assessment predicted that the intensity of dust dispersions from access road activities when there are dust control measures in place will be moderate at the access roads, and a low impact away from the road. Predicted PM₁₀ concentrations are within the new Malaysian Ambient Air Quality Guideline limits of 100 µg/m³ for the maximum 24-hour average concentration and 40 µg/m³ for the annual average concentration.

In cases when dust control measures are not adopted, predicted imposed PM₁₀ concentrations are likely to be well above the new Malaysian Ambient Air Quality Guideline limits. Thus, it is recommended that dust control measures be always implemented.

7.2.2 Operational Phase

During the operational phase of the HSR Project there are insignificant amount of air pollutants released but as train units are powered by electricity, greenhouse gases (GHG) are released indirectly by its operation.

However, this GHG emission is expected to be offset by the reduction in the number of motor vehicles and aircraft usage as users switch to HSR. With this switch in transportation mode, it is anticipated that there will be a positive impact of this project in terms of GHG emissions although the amount of reduction depends on transportation activities and fuel efficiency. This assessment aims to quantify the potential reduction in GHG through modal shift from motor vehicles and aircrafts to HSR. The only greenhouse gas of concern in this assessment is carbon dioxide (CO₂) as other GHG such as methane and nitrous oxide are released in insignificant amounts or not at all.

The GHG inventory is computed based on a simple offset formula with certain assumptions and projected data of the operation of the HSR. The nett amount of CO₂ avoided from modal shift of the HSR is computed based on the formula below;

Nett CO₂ avoided = calculated amount of CO₂ released avoided by motor vehicles (cars/buses), rail and aircraft – calculated amount of CO₂ resulting from HSR operation.

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The following assumptions were made in the calculations of CO₂ emissions.

- i) Modal split for air, cars, buses and rail based on impact of HSR on other modes (reference: Exhibit 50: Other Modes, Page 3-58, Chapter 3, Demand and Revenue) : 46%, 10%, 25% and 23%;
- ii) Average number of occupants for cars: 2.5 (reference: Exhibit 14: Vehicle Occupancy and Assumptions, Page 3-19, Chapter 3, Demand and Revenue);
- iii) CO₂ emission factor for private car: 193.28 g/ vehicle km (GEF, 2010);
- iv) CO₂ emission factor for bus passengers: 135.52 g/km pp (DEFRA, 2012);
- v) CO₂ emission factor for aircraft passengers (short haul; flight distance <785 km): 172.71 g/km pp (DEFRA, 2012);
- vi) Emission factor for normal passenger train: 50.0 g/km pp (Britain's Transport Infrastructure Rail Electrification, 2009); for high speed trains 40g/km.pp
- vii) Distance covered: 350 km, (length of HSR)
- viii) Ridership of HSR for year 2030 projection: 15,220,000 passengers

Based upon the above assumed criteria, the amount of avoided release of CO₂ induced by the HSR Project as a result of capturing commuters who otherwise would have travelled to Singapore from Kuala Lumpur by air, cars, bus and by KTM trains is estimated as follows:

- i) Aircraft ridership avoided because of HSR: $15,220,000 \times 46/100 = 7,001,200$ per annum.
- ii) Amount of CO₂ avoided: $(7,001,200 \times 172.71 \times 300) / (1,000,000) = 362,753.18$ tons per annum. (Flight distance between KLIA and Changi is taken as 300 km)
- iii) Car ridership avoided because of HSR: $15,220,000 \times 10/100 = 1,522,000$ per annum.
Number of car trips avoided: $1,522,000 / 2.5 = 608,800$ trips per annum.

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- iv) Amount of CO₂ avoided: $(608,800 \times 193.28 \times 365) / (1,000,000) = 42,949.14$ tons per annum.
- v) Bus ridership avoided because of HSR: $15,220,000 \times 25/100 = 3,805,000$ per annum
Amount of CO₂ avoided: $(3,805,000 \times 135.52 \times 365) / (1,000,000) = 188,213.56$ tons per annum.
- vi) Train ridership avoided because of HSR: $15,220,000 \times 23/100 = 3,500,600$ per annum
- vii) Amount of CO₂ avoided: $(3,500,600 \times 50.0 \times 365) / (1,000,000) = 63,885.95$ tons per annum.
- viii) Total amount of CO₂ released avoided by aircrafts, cars, buses and trains $362,753.18 + 42,949.14 + 188,213.56 + 63,885.95 = 657,801.82$ tons per annum.
- ix) Total amount of CO₂ released by ridership on HSR: $(15,220,000 \times 40.0 \times 365) / (1,000,000) = 222,212.0$ tons per annum.
- x) Nett CO₂ avoided: $657,801.82 - 222,212.00 = 435,589.82$ tons per annum.

This assessment showed that the HSR would **reduce 435,590 tons of CO₂ per year of operation** based on enticing passengers travelling by private motor vehicles, buses, KTM train and aircraft to use the HSR service. Besides the amount of CO₂ avoided, there are health benefits in the modal shift from private cars and buses to electrified trains although health benefits are difficult to be quantified. A study recently by Kwan (Kwan, et. al. 2017) “The Carbon Savings and Health Co-benefits from the Introduction of Mass Transit System in Greater Kuala Lumpur, Malaysia” showed that there are health benefits in such a switch. In addition, travelling by HSR transport could lead to lowering the rate of vehicular accidents, and resulting morbidity and mortality rates.

7.3 NOISE IMPACTS

7.3.1 Construction Phase

The assessment and evaluation of noise impacts are predicated on the potential activities that will be executed to construct the Project components. The list of these construction related activities that has potential noise impacts are summarised in **Table 7-3**:

Table 7-3: List of the Construction related Activities that has Potential Noise Impacts

| Main Project Activities | Sub-Project Activities |
|---|---|
| Stations, Depots and Maintenance Bases | Land Clearing |
| | Demolition |
| | Construction of Access Roads |
| | Earthworks |
| | Transportation of Materials / Equipment |
| | Vehicle Movement |
| | Traffic Diversion |
| | Piling |
| | Construction of Stations / Depots / Maintenance Bases |
| | Construction of Elevated Structures |
| | Construction of At-Grade Structures |
| | Utilities Relocation |
| Tracks Work (At-grade, Elevated, Tunnel and Bridge) | Land Clearing |
| | Demolition |
| | Construction of Access Roads |
| | Earthworks |
| | Transportation of Materials / Equipment |
| | Vehicle Movement |
| | Traffic Diversion |
| | Piling |
| | Construction of Elevated Structures / Bridges |
| | Construction of At-grade Structures |
| | Tunnelling |
| | Installation of Track |
| | Utilities Relocation |

The use of machines, equipment and vehicles for the construction of Project facilities will generate noise and vibrations; the intensity of which reduces as a function of distance away from their known position. The level of noise that will be generated at source depends on the

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type, number and power rating of the machineries employed. Noise levels of typical construction machinery and equipment, measured at specific distances away from its position are listed in **Table 7-4**. For example, the noise level (L_{eq}) measured within 10 m from an excavator is 83.3 dBA, which is then attenuated by 6 dB for every doubling of distance with potential for additional reduction in levels due to ground and atmospheric attenuations.

Table 7-4: Noise Levels for Typical Construction Machinery and Equipment

| Machinery / Equipment Involved | Sound Power Level (dBA) | Sound Pressure Level* (dBA) | | | | |
|--------------------------------|-------------------------|-----------------------------|------|------|-------|-------|
| | | 10 m | 25 m | 50 m | 100 m | 500 m |
| Impact pile driver: | | | | | | |
| - Pre-cast concrete pile | 120 | 90.3 | 82.1 | 75.7 | 69.3 | 53.4 |
| - H-section steel pile | 129 | 99.3 | 91.1 | 84.7 | 78.3 | 62.4 |
| Bulldozer | 112 | 82.3 | 74.1 | 67.7 | 61.3 | 45.4 |
| Excavator | 113 | 83.3 | 75.1 | 68.7 | 62.3 | 46.4 |
| Tractor | 108 | 78.3 | 70.1 | 63.7 | 57.3 | 41.4 |
| Truck / lorry | 120 | 90.3 | 82.1 | 75.7 | 69.3 | 53.4 |
| Grader | 120 | 90.3 | 82.1 | 75.7 | 69.3 | 53.4 |
| Generator (250 kVA) | 120 | 90.3 | 82.1 | 75.7 | 69.3 | 53.4 |
| Pump (Diesel) | 119 | 89.3 | 81.1 | 74.7 | 68.3 | 52.4 |

* Based on typical Malaysian climate (ambient temperature 30°, humidity 80%) and with 0.5 ground factor.

The allowable noise limits during the construction phase is specified by the DOE Noise Guidelines as per **Table 7-5**, where prediction of the sound pressure level is based on ISO 9316-1:1993 (Acoustics: Attenuation of sound during propagation outdoors – Part 1: Calculation of the absorption of sound by the atmosphere) and ISO 9316-2:1996 (Acoustics: Attenuation of sound during propagation outdoors – Part 2: General method of calculation).

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Table 7-5: Limiting Sound Levels for Construction, Demolition and Maintenance Works (Schedule 6, Annex A of the DOE Noise Guidelines)

| Category of Land Use | Day-time, dBA (7.00 am – 7.00 pm) | Evening, dBA (7.00 pm – 10.00 pm) | Night-time, dBA (10.00 pm – 7.00 am) |
|-----------------------|---|---|---|
| Noise Sensitive Areas | $L_{eq} = 50^*$ | $L_{eq} = 50^*$ | $L_{eq} = 40^*$ |
| Residential Areas | $L_{90} = 60$; $L_{10} = 75$ $L_{max} = 90$ | $L_{90} = 55$; $L_{10} = 70$ $L_{max} = 85$ | $L_{eq} = 40^*$ (low) or 45^* (medium) or 50^* (high) |
| Commercial | $L_{90} = 65$; $L_{10} = 75$ | $L_{90} = 60$; $L_{10} = 70$ | - |

*Limit may be based on Schedule 1, Annex 1. However, local authorities or DOE can impose a different limit.

Particular activities associated with the constructions, stations, depots, maintenance bases and tracks that could impose noise impacts on nearby receptors include:

1. Land Clearing
2. Demolition
3. Construction of Access Roads
4. Earthworks
5. Transportation of Materials / Equipment
6. Vehicle Movement
7. Traffic Diversion
8. Piling
9. Construction of Stations, Depots and Maintenance Bases
10. Construction of Elevated Structures / Bridges
11. Construction of At-grade Structures
12. Installation of Track
13. Tunnelling
14. Utilities Relocation

A) FT. Kuala Lumpur

During the construction of station at Bandar Malaysia, construction activities may cause adverse noise impacts to nearby residents located near the Bandar Malaysia Station such as in Taman Desa Seputeh located 300 m to the west of the site.

For construction of tracks (At-Grade, on Elevated structures and tunnel), the construction activities may also cause adverse impacts to nearby residents and noise sensitive areas located adjacent to the HSR alignment, where the tracks and tunnel are to be constructed. Based on the current measured noise levels at specific receptors located within 30-50 m to the HSR alignment, and taking due cognizance of the noise limits listed in **Table 7-5**, noise impacts imposed on receptors along Jalan JKR Salak Selatan and JKR Quarters (NK2) and Kg. Baru Salak Selatan (NK3) could be significant.

In general, residential areas and noise sensitive areas located less than 30 m or less than 50 m, respectively, from the alignment could be adversely impacted, in that L_{10} levels within such areas are predicted to increase by more than 10 dB from existing baseline values due to construction activities. Noise related impacts that can be imposed on surrounding receptors by the above-mentioned list of Project activities are described herewith.

I. **Noise from Land Preparation, Earthworks and Demolition Activities**

Land preparation and earthworks for construction of Bandar Malaysia Station and construction of tracks from Bandar Malaysia to the tunnel portal at Kg. Baru Salak Selatan involve the use of many noisy machinery and vehicles including bulldozers, excavators, graders and trucks. Demolition of old building and structures may also involve excavators and/or bulldozers. Depending on the type and number of machinery used in the working site, the noise level received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to residents and noise sensitive receptors near Bandar Malaysia Station at Taman Desa Seputeh, buildings along Jalan JKR Salak Selatan and at Kg. Baru Salak Selatan.

II. Noise induced by Vehicle Movements and Transportation of Materials and Equipment

Vehicle movement and transportation of construction materials and equipment to the site will involve the use of noisy vehicles such as trucks. In addition, construction of tunnel from Kg. Baru Salak Selatan to Serdang produces excavated materials that need to be transported out from the excavated sites using local roads in Kg. Baru Salak Selatan and/or Jalan UPM. Depending on the type and number of vehicle used, the noise level received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to residents and noise sensitive receptors near Bandar Malaysia Station at Taman Desa Seputeh, buildings along Jalan JKR Salak Selatan and at Kg. Baru Salak Selatan.

III. Noise from Construction of Access Roads

Construction of access roads for access to the sites, i.e., Station and sites for tracks involve the use of many noisy machinery and vehicles including bulldozers, excavators, graders and trucks. The noise level generated by these machineries and vehicles received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to residents and noise sensitive receptors near Bandar Malaysia Station at Taman Desa Seputeh, buildings along Jalan JKR Salak Selatan and at Kg. Baru Salak Selatan.

IV. Noise from Piling Activities

Noise generated by piling activities are impulsive in nature and are relatively more annoying than steady-state noise. The impact is going to be significant if conventional piling method were to be used. Depending on the pile used, noise from pile drivers can reaches up to 82-91 dBA at 25 m and 76-85 dBA at 50 m from the construction site as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas especially for piling locations that are close residential areas, where the alignment transverses high density populations such as around Bandar Malaysia, at Taman Desa Seputeh, buildings along Jalan JKR Salak Selatan and at Kg. Baru Salak Selatan.

V. Noise from Construction of Station

Noise generated due to construction of the Station at Bandar Malaysia involve piling and use of heavy machinery at the site and its access roads. Noise from heavy machinery in the construction site may involve generators, grinders and metal cutters. Depending on the type and number of machinery used in the working site, the noise level for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas in the vicinity of Bandar Malaysia Station such as at Taman Desa Seputeh.

VI. Noise from Construction of Elevated Structures and Bridges

Noise generated due to constructions of the elevated structures and bridges along the HSR alignment involve piling and use of heavy machinery at the site and its access roads. Depending on the type and number of machinery used in the working site, the noise level for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas as identified above, particularly at areas where the alignment transverses high density populations such as near Bandar Malaysia, at Taman Desa Seputeh, buildings along Jalan JKR Salak Selatan and at Kg. Baru Salak Selatan.

VII. Noise from Tunnelling

Noise generated due to tunnelling activities for tunnels along the HSR alignment involve use of TBM for tunnel location from Kg. Baru Salak Selatan to Jalan UPM, Serdang. In addition to tunnelling activities, high noise level can also be caused by movement of heavy vehicles carrying excavated materials and construction equipment from the tunnel portals in the construction site. These may cause nuisance to receptors located or residents living near tunnel portals such as at Kg. Baru Salak Selatan. The predicted sound level during tunnelling activity in Kg. Baru Salak Selatan is depicted in **Figure 7-45**, assuming that the vehicle carrying excavated materials and construction equipment travels at a speed of 40 km/hr along the existing road in the existing residential areas as shown. The noise propagation result shows that the noise contour of 65 dB represent the limit during

construction activities is generally located at a 15 m distance from the tunnel portal and 5 m from the road. Hence, any receptors located nearer from these distances will be affected by these activities.

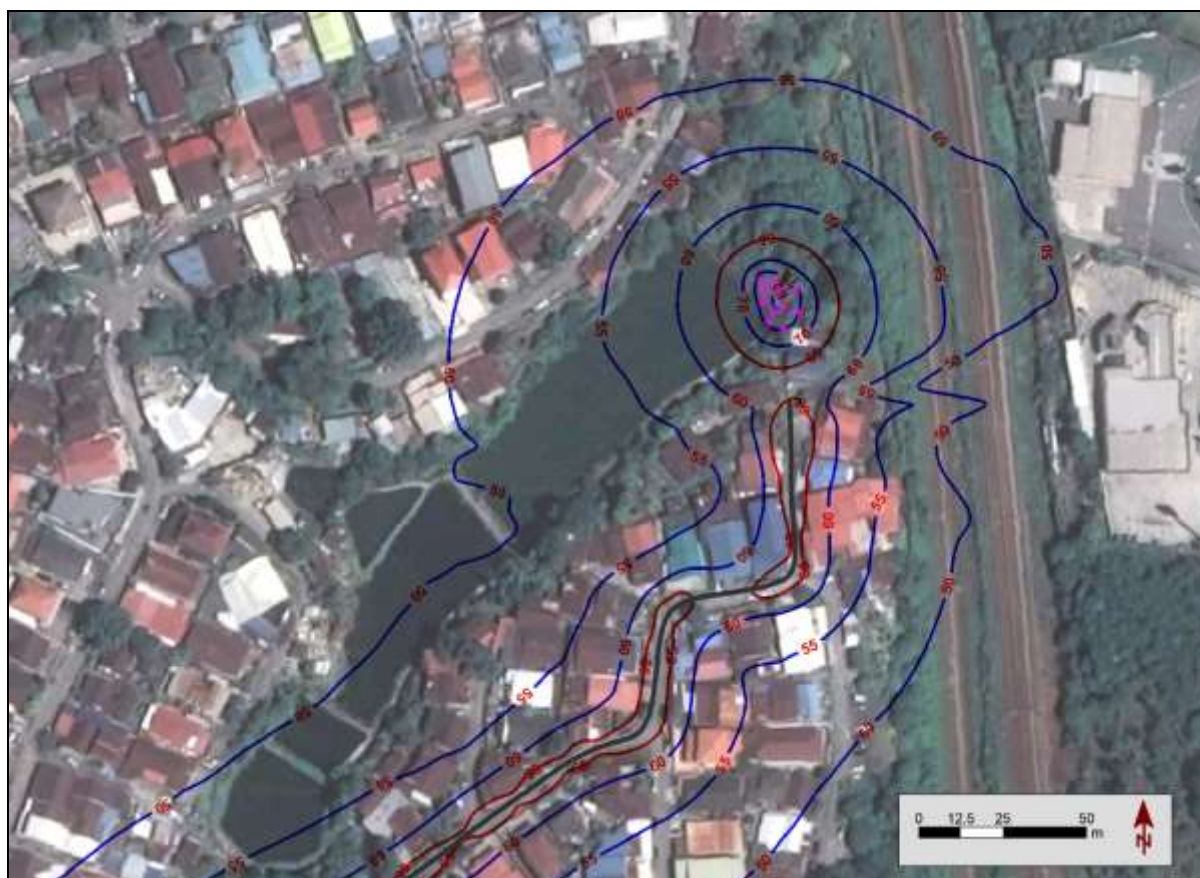


Figure 7-45: Predicted noise contours during the tunnelling construction phase at Kg Baru Salak Selatan (noise limit of 65 dBA shown by red lines)

VIII. Noise from Installation of Tracks

Noise generated due to installation of tracks at the elevated structures along the HSR alignment in Kuala Lumpur involves use of noisy machinery at the site and equipment, which can generate impulsive noise, such as impact hammers, grinders and metal cutters. Depending on the type and number of machinery used in the working site, the noise level for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas in Bandar Malaysia, Taman Desa Seputeh, Jalan JKR Salak Selatan and Kg. Baru Salak Selatan.

IX. Noise from Utilities Relocation

Utility relocation involves the use of several equipment and vehicles, which can emit high-level sound such as generators and lorries. The noise levels for the receivers within 50 m and 100 m of the site are expected to reach maximum levels of 72 dBA and 67 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas in Bandar Malaysia, Taman Desa Seputeh, Jalan JKR Salak Selatan and Kg. Baru Salak Selatan.

B) Selangor / FT. Putrajaya

During the construction of Sepang-Putrajaya Station and Light Depot and LMB in Serdang, construction activities may cause adverse noise impacts to nearby residents located near the Sepang-Putrajaya Station and Light Depot and LMB, such as near Kg. Dato' Abu Bakar Baginda and Kg. Sg. Merab Luar in Selangor and Diplomatic Precinct in FT. Putrajaya.

For construction of tracks (At-Grade, on Elevated structures and bridges), the construction activities may also cause adverse impacts to nearby residents and noise sensitive areas located adjacent to the HSR alignment, where the tracks are to be constructed. Based on the current measured noise levels at specific receptors located within 30-50 m to the HSR alignment, and taking due cognizance of the noise limits listed in **Table 7-5**, noise impacts imposed on receptors along Jalan UPM (NS4), along Persiaran Madani in UNITEN and Jalan Ayer Hitam (NS6), in Kg. Dato Abu Bakar Baginda (NS7), Kg. Sg. Merab Hulu (NS9), Persiaran Vista, Sepang (NS10) and Desa Bestari, Sepang (NS11) could be significant.

In general, residential areas and noise sensitive areas located less than 30 m or less than 50 m, respectively, from the alignment could be adversely impacted, in that L_{10} levels within such areas are predicted to increase by more than 10 dB from existing baseline values due to construction activities. Noise related impacts that can be imposed on surrounding receptors by the above-mentioned list of Project activities are described herewith.

I. Noise from Land Preparation, Earthworks and Demolition Activities

Land preparation and earthworks for construction of Stations, Depots and Maintenance Base as well as construction of tracks involve the use of many noisy machinery and vehicles

including bulldozers, excavators, graders and trucks. Demolition of old building and structures may also involve excavators and/or bulldozers. Depending on the type and number of machinery used in the working site, the noise level received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas in medium and high-density population near Sepang-Putrajaya Station, along Jalan UPM, Kg. Dato' Abu Bakar Baginda and Desa Bestari, Sepang as well as at higher education institutions and training centres along Jalan UPM, Jalan Sg. Besi and Jalan Ayer Hitam.

II. Noise induced by Vehicle Movements and Transportation of Materials and Equipment

Vehicle movement and transportation of construction materials and equipment to the sites will involve the use of noisy vehicles such as trucks. In addition, construction of tunnels at several locations in Selangor, namely part of the tunnel connecting Kg. Baru Salak Selatan and Serdang and the other two tunnels in Kg. Sg. Merab Hulu and Kg. Bukit Piatu, Dengkil, produces excavated materials that need to be transported out from the excavated sites. Depending on the type and number of vehicle used, the noise levels received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas as identified above, particularly along several state and federal routes, such as Jalan UPM, Jalan Sg. Besi, Jalan Ayer Hitam, Jalan Kg. Sg. Merab Hulu and Jalan Kajang-Dengkil.

III. Noise from Construction of Access Roads

Construction of access roads for access to the sites, at Sepang-Putrajaya Station and the Light Depot and LMB in Serdang as well as the tracks along the HSR alignment in Selangor / FT. Putrajaya, involves the use of many noisy machinery and vehicles including bulldozers, excavators, graders and trucks. The noise levels generated by these machineries and vehicles received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas as identified earlier.

IV. Noise from Traffic Diversions

Traffic diversion involves alteration of normal traffic routes temporarily, which may bring traffic closer to the residential and noise sensitive areas due to this diversion. This results in higher noise level experienced by the receptors living nearby the diverted routes. The affected roads include Jalan UPM, Jalan Sg. Besi, Jalan Ayer Hitam, Jalan Kg. Sg. Merab Hulu and Jalan Kajang-Dengkil. Depending on the traffic using the diverted routes, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas as identified earlier.

V. Noise from Piling Activities

Noise generated by piling activities are impulsive in nature and are relatively more annoying than steady-state noise. The impact is going to be significant if conventional piling method were to be used. Depending on the pile used, noise from pile drivers can reach up to 82-91 dBA at 25 m and 76-85 dBA at 50 m from the construction site as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas especially for piling locations that are close residential areas, where the alignment transverses high density populations such as near higher education institutions (UPM and UNITEN), training centres along Jalan Ayer Hitam, Kg. Dato' Abu Bakar Baginda, Persiaran Vista and Desa Bestari, Sepang.

VI. Noise from Construction of Stations, Depots and Maintenance Bases

Noise generated due to constructions of Sepang-Putrajaya Station and Light Depot and LMB will involve piling and use of heavy machinery at the site and its access roads. Noise from heavy machinery in the construction site may involve generators, grinders and metal cutters. Depending on the type and number of machinery used in the working site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas in the vicinity of Light Depot and LMB and Sepang-Putrajaya Station.

VII. Noise from Construction of Elevated Structures and Bridges

Noise generated due to construction of the elevated structures and bridges along the HSR alignment involve piling and use of heavy machinery at the site and its access roads. Depending on the type and number of machinery used in the working site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas as identified above, particularly at areas where the alignment transverses high density populations and noise sensitive areas such as higher education institutions (UPM and UNITEN), training centres along Jalan Ayer Hitam, Kg. Dato' Abu Bakar Baginda, Persiaran Vista and Desa Bestari, Sepang.

VIII. Noise from Construction of At-grade Structures

Noise generated due to construction of At-grade structures for the HSR alignment at Kg. Sg. Merab Hulu and Kg. Bukit Piatu involves use of heavy machinery at the site and its access roads, such as tractors and graders. Depending on the type and number of machinery used in the working site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to residential and noise sensitive areas as identified earlier such as Kg. Sg. Merab Hulu, Kg. Bukit Piatu, Jalan Kajang-Dengkil and near Bandar Baru Salak Tinggi.

IX. Noise from Tunnelling

Noise generated due to tunnelling activities for tunnels along the HSR alignment involve use of tunnels boring machines (TBM) for tunnel location from Kg. Baru Salak Selatan to Serdang and application of the New Austrian Tunnelling Method (NATM) for constructing the other two tunnels in Kg. Sg. Merab Hulu and Kg. Bukit Piatu, Dengkil. In locations of the tunnels where NATM is employed, the tunnelling method involves blasting which may cause sound waves to propagate in one dimension towards each of the tunnel portals. In addition to tunnelling activities, high noise level can also be caused by movement of heavy vehicles carrying excavated materials and construction equipment from the tunnel portals in the construction site. These may cause nuisance to receptors located or residents living near

tunnel portals at Taman Sri Serdang or Jalan UPM, Kg. Sg. Merab Hulu and Kg. Bukit Piatu, Dengkil. However, for receptors at another tunnel portal near Jalan UPM, Serdang, the area recorded a high baseline L_{eq} representing high noise climate due to heavy traffic from the nearby North-South (PLUS) highway. Hence, the impact at Jalan UPM, Serdang is not as significant as in other areas.

X. Noise from Installation of Tracks

Noise generated due to installation of tracks along the HSR alignment involves use of noisy machinery at the site and equipment, which can generate impulsive noise, such as impact hammers, grinders and metal cutters. Depending on the type and number of machinery used in the working site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas as identified above particularly that involve high pitch sound and impulsive noise.

XI. Noise from Utilities Relocation

Utility relocation involves the use of several equipment and vehicles, which can emit high-level sound such as generators and lorries. The noise levels for the receivers within 50 m and 100 m of the site are expected to reach maximum levels of 72 dBA and 67 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas Jalan UPM, Kg. Dato' Abu Bakar Baginda and Desa Bestari, Sepang as well as at higher education institutions (UPM and UNITEN) and training centres along Jalan Ayer Hitam.

C) Negeri Sembilan

During the construction of Seremban Station, construction activities may cause adverse noise impacts to nearby residents located near the Station. For construction of tracks (At-Grade, on Elevated Structures and Bridges), the construction activities may also cause adverse impacts to nearby residents and noise sensitive areas located adjacent to the HSR alignment, where the tracks are to be constructed. Based on the current measured noise levels at specific receptors located within 30-50 m to the HSR alignment, and taking due cognizance of the noise limits listed in **Table 7-5**, noise impacts imposed on receptors at

Desa Cempaka, Nilai (may be represented by NS11), Sendayan (NN4), Siliu (NN6) and Taman Sungai Ujong (NN7) could be significant.

I. Noise from Land Preparation, Earthworks and Demolition Activities

Land preparation and earthworks for construction of Seremban Station as well as construction of tracks along the HSR alignment in Negeri Sembilan involve the use of many noisy machinery and vehicles including bulldozers, excavators, graders and trucks. Demolition of old building and structures may also involve excavators and/or bulldozers. Depending on the type and number of machinery used in the working site, the noise levels received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas such as in Desa Cempaka and Kota Seriemas in Nilai, Taman Gadong Putra and Taman Cermat Utama in Labu and Felda Sri Sendayan.

II. Noise induced by Vehicle Movements and Transportation of Materials and Equipment

Vehicle movement and transportation of construction materials and equipment to the site will involve the use of noisy vehicles such as trucks. In addition, construction of two (2) tunnels of less than 500 m long in Siliu, produces excavated materials that need to be transported out from the excavated sites. Depending on the type and number of vehicle used, the noise levels received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas along Federal Route 53 and State Route N6 (Jalan Siliu).

III. Noise from Construction of Access Roads

Construction of access roads for access to the sites at Seremban Station and the HSR alignment in Negeri Sembilan involves the use of many noisy machinery and vehicles including bulldozers, excavators, graders and trucks. The noise levels generated by these machineries and vehicles received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in

Table 7-4. These activities can be a nuisance to nearby residential and noise sensitive areas in Desa Cempaka and Kota Seriemas in Nilai, Taman Gadong Putra and Taman Cermat Utama in Labu, Felda Sri Sendayan and Taman Sg. Ujong, Siliau.

IV. Noise from Traffic Diversions

Traffic diversion involves alteration of normal traffic routes temporarily, which may bring traffic closer to the residential and noise sensitive areas due to this diversion. This results in higher noise level experienced by the receptors living nearby the diverted routes. Depending on the traffic using the diverted routes, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas in Desa Cempaka and Kota Seriemas in Nilai, Taman Gadong Putra and Taman Cermat Utama in Labu, Felda Sri Sendayan and Taman Sg. Ujong, Siliau.

V. Noise from Piling Activities

Noise generated by piling activities are impulsive in nature and are relatively more annoying than steady-state noise. The impact is going to be significant if conventional piling method were to be used. Depending on the pile used, noise from pile drivers can reaches up to 82-91 dBA at 25 m and 76-85 dBA at 50 m from the construction site as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas especially for piling locations that are close to residential areas, where the alignment transverses medium- and high-density populations in Desa Cempaka and Kota Seriemas in Nilai, Taman Gadong Putra and Taman Cermat Utama in Labu, Felda Sri Sendayan and Taman Sg. Ujong, Siliau.

VI. Noise from Construction of Station

Noise generated due to construction of Seremban Station involves piling and use of heavy machinery at the site and its access roads. Noise from heavy machinery in the construction site may involve generators, grinders and metal cutters. Depending on the type and number of machinery used in the working site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise

sensitive areas in the vicinity of Seremban Station. However, since the nearest receptor from Seremban Station is at Bandar Baru Enstek which is located about 1.2 km, the impact to the nearest receptor is negligible.

VII. Noise from Construction of Elevated Structures and Bridges

Noise generated due to constructions of the Elevated Structures and Bridges along the HSR alignment involve piling and use of heavy machinery at the site and its access roads. Depending on the type and number of machinery used in the working site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas as identified above, particularly at areas where the alignment transverses medium- and high-density populations in Desa Cempaka and Kota Seriemas in Nilai, Taman Gadong Putra and Taman Cermat Utama in Labu, Felda Sri Sendayan and Taman Sg. Ujong, Siliau.

VIII. Noise from Construction of At-Grade Structures

Noise generated due to construction of At-Grade Structures for the tracks along the HSR alignment involves use of heavy machinery at the site and its access roads, such as tractors and graders. Depending on the type and number of machinery used in the working site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas as identified above. However, since none of At-Grade tracks is near the populated areas, the noise impact to the nearest receptors from At-Grade Structures is negligible.

IX. Noise from Tunnelling

Noise generated due to tunnelling activities for tunnels along the HSR alignment involve application of NATM for constructing two tunnels of less than 500 m long in Siliau. As NATM involves blasting, it may cause sound waves to propagate in one dimension towards each of the tunnel portals. However, since the nearest receptor is at least 850 m away from any of the tunnel portals, this impact is negligible.

X. Noise from Installation of Tracks

Noise generated due to installation of tracks along the HSR alignment involves use of noisy machinery at the site and equipment, which can generate impulsive noise, such as impact hammers, grinders and metal cutters. Depending on the type and number of machinery used in the working site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to residential and noise sensitive areas in Desa Cempaka and Kota Seriemas in Nilai, Taman Gadong Putra and Taman Cermat Utama in Labu, Felda Sri Sendayan and Taman Sg. Ujong, Siliau, particularly that involve high pitch sound and impulsive noise.

XI. Noise from Utilities Relocation

Utility relocation involves the use of several equipment and vehicles, which can emit high-level sound such as generators and lorries. The noise levels for the receivers within 50 m and 100 m of the site are expected to reach maximum levels of 72 dBA and 67 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas in Desa Cempaka and Kota Seriemas in Nilai, Taman Gadong Putra and Taman Cermat Utama in Labu, Felda Sri Sendayan and Taman Sg. Ujong, Siliau.

D) Melaka

During the construction of Melaka Station, construction activities may cause adverse noise impacts to nearby residents located near the Melaka Station. For construction of tracks (At-Grade, on Elevated Structures and Bridges), the construction activities may also cause adverse impacts to nearby residents and noise sensitive areas located adjacent to the HSR alignment, where the tracks are to be constructed. Based on the current measured noise levels at specific receptors located within 30-50 m to the HSR alignment, and taking due cognizance of the noise limits listed in **Table 7-4**, noise impacts imposed on receptors near IKBN Alor Gajah (NM2), near Masjid Air Limau, Masjid Tanah (NM3), Taman Paya Rumput Indah (NM5), 1 Krubong Residence (NM6), Kolej Yayasan Saad in Bemban (NM9), Pusat Rehabilitasi PERKESO Melaka (NM10) and Kg. Solok Hilir (NM11) and Taman Bemban Baru (NM12) could be significant.

In general, residential areas and noise sensitive areas located less than 30 m or less than 50 m, respectively, from the HSR alignment could be adversely impacted, in that L_{10} levels within such areas are predicted to increase by more than 10 dB from existing baseline values due to construction activities. Noise related impacts that can be imposed on surrounding receptors by the above-mentioned list of Project activities are described herewith.

I. Noise from Land Preparation, Earthworks and Demolition Activities

Land preparation and earthworks for construction of Melaka Station as well as construction of tracks involve the use of many noisy machinery and vehicles including bulldozers, excavators, graders and trucks. Demolition of old building and structures may also involve usage of heavy machineries such as excavators and/or bulldozers. Depending on the type and number of machinery used in the working site, the noise levels received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to residents in Masjid Tanah, Taman Paya Rumput Indah, 1 Krubong Residence, Durian Tunggal, Kg. Ulu Duyung, Taman Bemban Jaya Taman Bemban Baru and Kg. Bemban, as well as in noise sensitive areas, namely IKBN Alor Gajah, Kolej Yayasan Saad and Pusat Rehabilitasi PERKESO Melaka.

II. Noise induced by Vehicle Movements and Transportation of Materials and Equipment

Vehicle movement and transportation of construction materials and equipment to the site will involve the use of noisy vehicles such as trucks. Depending on the type and number of vehicle used, the noise levels received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-18**. These activities can be a nuisance to residents in Masjid Tanah, Taman Paya Rumput Indah, 1 Krubong Residence, Durian Tunggal, Kg. Ulu Duyung, Taman Bemban Jaya, Taman Bemban Baru and Kg. Bemban, as well as in noise sensitive areas, namely IKBN Alor Gajah, Kolej Yayasan Saad and Pusat Rehabilitasi PERKESO Melaka.

III. Noise from Construction of Access Roads

Construction of access roads for access to the sites, i.e., Station as well as sites for tracks involve the use of many noisy machinery and vehicles including bulldozers, excavators, graders and trucks. The noise levels generated by these machineries and vehicles received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to residents in Masjid Tanah, Taman Paya Rumput Indah, 1 Krubong Residence, Durian Tunggal, Kg. Ulu Duyung, Taman Bemban Jaya Taman Bemban Baru and Kg. Bemban, as well as in noise sensitive areas, namely IKBN Alor Gajah, Kolej Yayasan Saad and Pusat Rehabilitasi PERKESO Melaka.

IV. Noise from Traffic Diversions

Traffic diversion involves alteration of normal traffic routes temporarily, which may bring traffic closer to the residential and noise sensitive areas due to this diversion. This results in higher noise levels experienced by the receptors living nearby the diverted routes. Depending on the traffic using the diverted routes, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to residents in Masjid Tanah, Taman Paya Rumput Indah, 1 Krubong Residence, Durian Tunggal, Kg. Ulu Duyung, Taman Bemban Jaya and Taman Bemban Baru, as well as in noise sensitive areas, namely IKBN Alor Gajah, Kolej Yayasan Saad and Pusat Rehabilitasi PERKESO Melaka.

V. Noise from Piling Activities

Noise generated by piling activities are impulsive in nature and are relatively more annoying than steady-state noise. The impact is going to be significant if conventional piling method were to be used. Depending on the pile used, noise from pile drivers can reaches up to 82-91 dBA at 25 m and 76-85 dBA at 50 m from the construction site as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas especially for piling locations that are close residential areas, where the alignment transverses medium- and high-density populations in Masjid Tanah, Taman Paya Rumput Indah, 1 Krubong Residence, Durian Tunggal, Kg. Ulu Duyung, Taman Bemban Jaya and Taman

Bemban Baru, as well as noise sensitive areas, namely IKBN Alor Gajah, Kolej Yayasan Saad and Pusat Rehabilitasi PERKESO Melaka.

VI. Noise from Construction of Station

Noise generated due to construction of Melaka Station involve piling and use of heavy machinery at the site and its access roads. Noise from heavy machinery in the construction site may involve generators, grinders and metal cutters. Depending on the type and number of machinery used in the working site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residents and noise sensitive receptors in the vicinity of Melaka Station.

VII. Noise from Construction of Elevated Structures and Bridges

Noise generated due to constructions of the Elevated Structures and Bridges along the HSR alignment involve piling and use of heavy machinery at the site and its access roads. Depending on the type and number of machinery used in the working site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas as identified above, particularly at areas where the alignment transverses medium- and high-density populations in Masjid Tanah, Taman Paya Rumput Indah, 1 Krubong Residence, Durian Tunggal, Kg. Ulu Duyung, Taman Bemban Jaya and Taman Bemban Baru, as well as in noise sensitive areas, namely IKBN Alor Gajah, Kolej Yayasan Saad and Pusat Rehabilitasi PERKESO Melaka.

VIII. Noise from Construction of At-Grade Structures

Noise generated due to construction of At-Grade structures for the tracks along the HSR alignment involves use of heavy machinery at the site and its access roads, such as tractors and graders. Depending on the type and number of machinery used in the working site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to residents in Masjid Tanah, Durian Tunggal, Taman Bemban Jaya and Kg. Bemban.

IX. Noise from Installation of Tracks

Noise generated due to installation of tracks along the HSR alignment involves use of noisy machinery at the site and equipment, which can generate impulsive noise, such as impact hammers, grinders and metal cutters. Depending on the type and number of machinery used in the working site, the noise level for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to residents in Masjid Tanah, Taman Paya Rumput Indah, 1 Krubong Residence, Durian Tunggal, Taman Bemban Jaya and Taman Bemban Baru and Kg. Bemban, as well as in noise sensitive receptors, namely IKBN Alor Gajah, Kolej Yayasan Saad and Pusat Rehabilitasi PERKESO Melaka, particularly that involve high pitch sound and impulsive noise.

X. Noise from Utilities Relocation

Utility relocation involves the use of several equipment and vehicles, which can emit high-level sound such as generators and trucks. The noise level for the receivers within 50 m and 100 m of the site are expected to reach maximum levels of 72 dBA and 67 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to residents in Masjid Tanah, Taman Paya Rumput Indah, 1 Krubong Residence, Durian Tunggal, Kg. Ulu Duyung, Taman Bemban Jaya and Taman Bemban Baru and Kg. Bemban, as well as in noise sensitive receptors, namely IKBN Alor Gajah, Kolej Yayasan Saad and Pusat Rehabilitasi PERKESO Melaka.

E) Johor

During the construction of Muar Station, Batu Pahat Station, Iskandar Puteri Station, Heavy Maintenance Base (HMB) in Muar and Main Depot and Light Maintenance Base (LMB) in Pekan Nenas, Pontian, construction activities may cause adverse noise impacts to nearby residents located near the Stations, Depot and Maintenance Bases. For construction of tracks (At-Grade, on Elevated Structure, Bridges and Tunnels), the construction activities may also cause adverse impacts to nearby residents and noise sensitive areas located adjacent to the HSR alignment, where the tracks are to be constructed. Based on the current measured noise levels at specific receptors located within 30-50 m to the HSR alignment,

and taking due cognizance of the noise limits listed in **Table 7-5**, noise impacts imposed on receptors at the following locations could be significant:

- Noise sensitive receptors
 - NJ15 (Pertubuhan Kebajikan Warga Emas Pontian);
 - NJ4 (SK Pekan Pagoh);
 - NJ11 (SMK Dato' Ibrahim Majid, Simpang Renggam);
 - NJ20 (SK Tanjung Kupang).
- Receptors in medium- and high-populated areas
 - NJ1 (along Jalan Bukit Gambir);
 - NJ2 (Kg. Jawa);
 - NJ7 (Kg. Parit Yaani Tengah);
 - NJ9 (Kg. Seri Menanti Laut);
 - NJ10 (Kg. Parit Lapis Kadir Darat);
 - NJ13 (Kg. Melayu Raya).

In general, residential areas and noise sensitive areas located less than 30 m or less than 50 m, respectively, from the HSR alignment could be adversely impacted, in that L_{10} levels within such areas are predicted to increase by more than 10 dB from existing baseline values due to construction activities. Noise related impacts that can be imposed on surrounding receptors by the above-mentioned list of Project activities are described herewith.

I. Noise from Land Preparation, Earthworks and Demolition Activities

Land preparation and earthworks for construction of stations, depots and maintenance base as well as construction of tracks involve the use of many noisy machinery and vehicles including bulldozers, excavators, graders and trucks. Demolition of old building and structures may also involve heavy machineries such as excavators and/or bulldozers. Depending on the type and number of machinery used in the working site, the noise levels received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas in Bukit Gambir, Panchor, Pagoh, Parit Yaani, Parit Sulong, Simpang Renggam, Pekan Nenas, Gelang Patah and Tanjung Kupang.

II. Noise induced by Vehicle Movements and Transportation of Materials and Equipment

Vehicle movement and transportation of construction materials and equipment to the site will involve the use of noisy vehicles such as trucks. In addition, construction of two (2) tunnels near Kg. Tanah Merah Pagoh, produces excavated materials that need to be transported out from the excavated sites. Depending on the type and number of vehicle used, the noise level received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas as identified above, particularly along local roads in Kg. Tanah Merah Pagoh and Jalan Pagoh.

III. Noise from Construction of Access Roads

Construction of access roads for access to the sites, i.e., the three stations in Muar, Batu Pahat and Iskandar Puteri, depot and maintenance bases in Muar and Pontian as well as sites for tracks involve the use of many noisy machinery and vehicles including bulldozers, excavators, graders and trucks. The noise levels generated by these machineries and vehicles received by the receptors within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas in Bukit Gambir, Panchor, Pagoh, Parit Yaani, Parit Sulong, Simpang Renggam, Pekan Nenas, Gelang Patah and Tanjung Kupang.

IV. Noise from Traffic Diversions

Traffic diversion involves alteration of normal traffic routes temporarily, which may bring traffic closer to the residential and noise sensitive areas due to this diversion. This results in higher noise levels experienced by the receptors living nearby the diverted routes. Depending on the traffic using the diverted routes, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas in Bukit Gambir, Panchor, Pagoh, Parit Yaani, Parit Sulong, Simpang Renggam, Pekan Nenas, Gelang Patah and Tanjung Kupang.

V. Noise from Piling Activities

Noise generated by piling activities are impulsive in nature and are relatively more annoying than steady-state noise. The impact is going to be significant if conventional piling method were to be used. Depending on the pile used, noise from pile drivers can reach up to 82-91 dBA at 25 m and 76-85 dBA at 50 m from the construction site as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas especially for piling locations that are close residential areas, where the alignment transverses medium- and high-density populations and noise sensitive receptors in Bukit Gambir, Panchor, Pagoh, Parit Yaani, Parit Sulong, Simpang Renggam, Pekan Nenas, Gelang Patah and Tanjung Kupang.

VI. Noise from Construction of Stations, Depots and Maintenance Bases

Noise generated due to constructions of the stations, depots and maintenance bases involve piling and use of heavy machinery at the sites and its access roads. Noise from heavy machinery in the construction sites may involve generators, grinders and metal cutters. Depending on the type and number of machinery used in the working site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. For Muar and Iskandar Puteri Stations and HMB at Muar, as the sites are located more than 500 m away from nearest residents or noise sensitive receptors, noise impact is generally minimal. However, for Batu Pahat Stations and Main Depot and LMB, Pontian, its construction activities can be a nuisance for receptors in the nearby residential areas, namely Taman Pura Kencana and Pekan Nenas, which are respectively located less than 200 m from the sites.

VII. Noise from Construction of Elevated structures and Bridges

Noise generated due to constructions of the Elevated structures and Bridges along the HSR alignment involve piling and use of heavy machinery at the site and its access roads. Depending on the type and number of machinery used in the working site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas as identified above, particularly at areas where the alignment transverses medium- and high-density populations and noise

sensitive receptors in Bukit Gambir, Panchor, Pagoh, Parit Yaani, Parit Sulong, Simpang Renggam, Pekan Nenas, Gelang Patah and Tanjung Kupang.

VIII. Noise from Construction of At-Grade Structures

Noise generated due to construction of At-Grade structures for the tracks along the HSR alignment involves use of heavy machinery at the site and its access roads, such as tractors and graders. Depending on the type and number of machinery used in the working site, the noise level for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residents and noise sensitive receptors in Bukit Gambir, Panchor, Pagoh, Parit Yaani, Parit Sulong, Simpang Renggam, Pekan Nenas, Gelang Patah and Tanjung Kupang.

IX. Noise from Tunnelling

Noise generated due to tunnelling activities for tunnels along the HSR alignment involve employing NATM for constructing two (2) tunnels of 700-900 m long near Kg. Tanah Merah Pagoh. As NATM involves blasting, it may cause sound waves to propagate in one (1) dimension towards each of the tunnel portals. This may cause nuisance to receptors located or residents living near tunnel portals at Kg. Tanah Merah Pagoh. However, as the nearest receptors is about 1.8 km from the nearest tunnel portal, the noise impact is negligible.

X. Noise from Installation of Tracks

Noise generated due to installation of tracks along the HSR Alignment involves use of noisy machinery in the project site and equipment, which can generate impulsive noise, such as impact hammers, grinders and metal cutters. Depending on the type and number of machinery used in the working site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residents and noise sensitive receptors in Bukit Gambir, Panchor, Pagoh, Parit Yaani, Parit Sulong, Simpang Renggam, Pekan Nenas, Gelang Patah and Tanjung Kupang, particularly that involve high pitch sound and impulsive noise.

XI. Noise from Utilities Relocation

Utility relocation involves the use of several equipment and vehicles, which can emit high-level sound such as generators and lorries. The noise levels for the receivers within 50 m and 100 m of the site are expected to reach maximum levels of 72 dBA and 67 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residents and noise sensitive receptors in Bukit Gambir, Panchor, Pagoh, Parit Yaani, Parit Sulong, Simpang Renggam, Pekan Nenas, Gelang Patah and Tanjung Kupang.

7.3.2 Operational Phase

The main activities that will be carried out by the Project Proponent during the operational phase are listed in **Table 7-6**.

Table 7-6: Project Activities during Operational Phase

| Main Project Activities | Sub-Project Activities |
|---|--|
| Stations, Depots and Maintenance Bases | Road Traffic Flow |
| | Movement of Trains |
| | Stations / Depots / Maintenance Bases Activities |
| Tracks Work (At-grade, Elevated, Tunnel and Bridge) | Movement of Trains at High Speed |
| | Repair and Maintenance Works on Tracks |

During operations, noise is emitted from the trains due to its high speed movement, which may be more significant when their operating frequencies increases and when travelling velocities are greater than 300 km/hr. Apart from train operations, noise can be generated from associated activities such as road diversions which may result in roads being closer to certain receptors than previously, as well as any repair and maintenance works that are required in the events of train derailment and collision. The latter events will require deployment and the operation of heavy machinery and equipment. The intensity of noise impacts transmitted to surrounding receptors due to the Project activities depends on the relative distance separating the receptors from the train. Baseline noise levels and their tone characteristics will influence the degree of annoyance felt by humans and surrounding communities.

CHAPTER 7: EVALUATION OF IMPACTS

Movement of trains at high speed inevitably increases the sound pressure levels along and perpendicular to its pathway particularly when passing a certain area several times. This noise typically originates from the train's propulsion system that includes traction motors, cooling fans, gears, auxiliary equipment, rolling noise from wheel-rail interaction and the train's aerodynamic sources, such as vortex shedding from the wheels, pantograph, train nose and tail, edges and cavities. In addition to these sources, noise can also be generated at the tunnel exits due to rapid propagation of micro-pressure waves within tunnel portals. As the speed increases, the sound level increases and the component of noise sources which becomes more significant at higher speed is the aerodynamic noise component. However, when approaching a Station, depending on the type of service, the train will decelerate to a speed limit of either 170 km/h for an express Kuala Lumpur-Singapore service, or to a complete stop for a domestic interstate service. This will result in lower sound levels generated due to train movements. When leaving the Station, the train gradually accelerates until it reaches a specified speed limit (normally 200 km/h) at certain areas in FT. Kuala Lumpur, Selangor and Singapore or a maximum operating speed of 320 km/h.

In order to quantitatively predict the increment of noise levels along the HSR alignment, a computer simulation was performed, employing the universally recognised **Sound Plan software**. The model and standards used included the Schall 03 (2006) version for correlation for the train noise sources; ISO 3095:2005 (Acoustics: Railway applications – Measurement of noise emitted by rail bound); and ISO 9316-2 for sound propagation in the environment due to other factors. The Schall 03 (2006) model takes into account aerodynamic noise, propulsion noise and equipment noise as well as any identified gradients and track curvatures leading to the increment or decrement of sound levels.

The Sound Exposure Level (SEL) was estimated for every 20 m segment along the HSR alignment employing information provided by the Project Proponent. These included (a) the train speed table, (b) train lengths and configuration, (c) projected train frequencies in years 2030 and 2060, (d) the latest HSR alignment and track vertical layout, and (e) the land topography along the HSR alignment. Based on the average train speed derived from the train speed table and train frequency, SEL represents the cumulative exposure over an event including sound 10 dB down from the maximum normalised to 1 second. The resulting SEL generated by this model has been verified with high speed trains operating in many countries in Europe such as France and Germany as well as in East Asia such as South Korea and Japan. Since the train only operates from 06:00 to 00:00 hours, the simulation

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was run for the day-time data for the year 2030 (160 trips for express service; 124 trips for domestic service; and 98 trips for shuttle service); and for year 2060 (298 trips for express service; 226 trips for domestic service; and 184 trips for shuttle service). During the non-operating hours from 00:00 to 06:00 hours, the noise impact will be generally minimal, except when periodic rail grinding operations are carried out. However, the impact due to rail grinding operations will be short term and will not be a stationary sound emission event.

Due to high speed of the trains passing several times in one hour from 6.00 a.m. to 12.00 a.m. every day, a number of nearby residents and noise sensitive recipients living within 70-360 m from the HSR alignment are going to experience a high sound level which needs to be mitigated using noise barriers. The kind and height of barriers depend on type of tracks (At-Grade or on Elevated Structure) land topography and environmental condition in the surrounding area. Generally, depending on the local land use and the maximum operating speed of 320 km/h, the averaged minimum distance of the recipients / residents from the HSR alignment that is required to attenuate the sound pressure level to a limit below that stipulated by the DOE Noise Guidelines is given in **Table 7-7**. If the distance of a receptor is less than the minimum distance given by **Table 7-7**, the sound pressure level has to be reduced either by natural means such as via area topography or by using man-made landform or structures such as noise berms or noise barriers. The requirement for such noise abatement method is more critical in year 2060 due to higher frequency of trains travelling at high speed on daily basis.

Table 7-7: Averaged Minimum Distance for Nearest Receptors for Noise Barriers

| Category of Land Use | Day-time Limit ¹ , dBA (7.00 am – 10.00 pm) | Minimum Distance ² , m | |
|--|---|-----------------------------------|------|
| | | 2030 | 2060 |
| Noise Sensitive Areas Low Density Residential Areas | 60 | 163 | 355 |
| Suburban and Urban Residential Areas | 65 | 76 | 171 |
| Commercial, Business | 70 | 37 | 82 |

¹Based on Schedule 5, Annex 1 of the 2007 DOE Noise Guidelines.

²Minimum distance derived from three locations in Negeri Sembilan, Melaka and Johor, having a generally planar area with maximum operating speed of 320 km/h.

Particular activities associated with the operation of trains, stations, depots and maintenance bases that could impose noise impacts on nearby receptors include:

1. Road Traffic Flow
2. Movement of Trains
3. Stations / Depots / Maintenance Bases operational activities
4. Repair and Maintenance Work on Tracks

These activities have the potential to induce adverse noise impacts on nearby residents, and noise sensitive areas, located near to the HSR alignment where the tracks will be placed; especially for those receptors located 30-50 m from the tracks, given that the existing noise originating from other sources in the surrounding area such as road traffic is relatively low. The anticipated increase in sound levels at potential receptors is discussed in the following narrative according to states, including noise modelling results from software simulation.

A) FT. Kuala Lumpur

I. Noise from Movement of Trains at High Speed and Approaching / Leaving Station

Movement of trains at high speed will increase the sound pressure levels along and the sound waves propagate perpendicular to its pathway particularly when passing a certain area several times. However, noise impact in FT. Kuala Lumpur area is not as significant as the other states mainly due to enforcement of certain speed limit of 200 km/h between Bandar Malaysia Station and Sepang-Putrajaya Station and a large part of the HSR alignment is underground, i.e., from Kg. Baru Salak Selatan to Serdang.

In order to predict noise impact due to train movement, noise modelling has been carried out over the HSR alignment in FT. Kuala Lumpur based on methodology described above. Arising from the computer simulation, the predicted noise level increments deduced at selected receptors located adjacent to the HSR alignment are summarised in following **Table 7-8:**

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Table 7-8: Predicted Increment of Noise Levels at Selected Receptors in FT. Kuala Lumpur

| Receptor Ref (a) | L_{eq}^* (dBA) | Limit** (dBA) | Distance from Track (m) | Simulated 2030 (dBA) | Simulated 2060 (dBA) | Increment 2030 (dBA) | Increment 2060 (dBA) | Remarks |
|------------------|------------------|---------------|-------------------------|----------------------|----------------------|----------------------|----------------------|------------------|
| NK1 | 58.3 | 70 | 44 | 59.0 | 60.2 | 0.7 | 1.9 | Train at station |
| NK2 | 59.8 | 65 | 14 | 60.8 | 64.4 | 1.0 | 4.6 | Station exit |
| NK3 | 59.6 | 65 | 20 | 63.7 | 67.3 | 4.1 | 7.7 | Computed at 25 m |
| NK4 | 58.4 | 65 | 25 | 58.4 | 58.4 | 0.0 | 0.0 | Train in tunnel |
| NK5 | 59.1 | 61.1 | 5 | 59.1 | 59.1 | 0.0 | 0.0 | Train in tunnel |
| NK6 | 66.5 | 68.5 | 57 | 66.5 | 66.5 | 0.0 | 0.0 | Train in tunnel |
| NK7 | 62.5 | 65 | 69 | 62.5 | 62.5 | 0.0 | 0.0 | Train in tunnel |
| NK8 | 63.0 | 65 | 81 | 63.0 | 63.0 | 0.0 | 0.0 | Train in tunnel |

* L_{eq} from baseline monitoring

** Noise limit is derived from combination of Schedule 2, Schedule 3 and Schedule 5 of the 2007 DOE Noise Guidelines.

Comparing the simulated noise levels denoted in **Table 7-8** (labelled as “Simulated 2030” and “Simulated 2060”) with the limits specified under the DOE noise guidelines, the magnitude of noise level increments at the receptor locations can be gauged. The predicted sound levels are computed at residential or noise sensitive areas located in the vicinity of the Project’s noise and vibration sampling stations (herewith re-designated as receptors), either closer to or farther from the HSR alignment as indicated in the columns labelled as “Distance from Track” or “Remark” in the same table, assuming that the measured L_{eq} can still reflect the baseline sound levels in those areas. The results of the computer simulation are also presented in detail in **Appendix 7F** according to states.

II. Noise due to Activities at Station and Repair and Maintenance Work on Tracks

Noise generated due to Station activities performed at Bandar Malaysia Station as well as repair and maintenance works on the tracks involve use of heavy machinery and equipment at the Bandar Malaysia Station and/or its tracks. The repair works may also include repairs after any train derailment and collision events. Noise from heavy machinery and equipment

such as generators, grinders and metal cutters at the site and at the tracks would increase the sound pressure levels from its existing ambient values. Depending on the type and number of machinery used in the work site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas along Jalan JKR Salak Selatan, in Taman Desa Seputeh and in Kg. Baru Salak Selatan.

B) Selangor / FT. Putrajaya

I. Noise from Movement of Trains at High Speed and Approaching / Leaving Station

Movement of trains at high speed will increase the sound pressure levels along and the sound waves propagate perpendicular to its pathway particularly when passing a certain area several times. Noise impact for areas between FT. Kuala Lumpur and Sepang-Putrajaya Station is not as significant as the other states and other parts of Selangor which is mainly due to the application of speed limit of 200 km/h between both destinations. In addition, a large part of the HSR alignment is underground, i.e., from Kg. Baru Salak Selatan to Serdang. However, from Sepang-Putrajaya Station towards Negeri Sembilan border, train speed may reach its maximum operating speed of 320 km/h in Dengkil and Salak Tinggi, which leads to significant noise impact.

In predicting noise impact due to train movement, noise modelling has been carried out over the HSR alignment in Selangor / FT. Putrajaya based on methodology described above. Arising from the computer simulation, the predicted noise level increments deduced at selected receptors located adjacent to the HSR alignment are summarised in **Table 7-9** below:

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Table 7-9: Predicted Increment of Noise Levels at Selected Receptors in
Selangor / FT. Putrajaya

| Receptor Ref (a) | L_{eq}^* (dBA) | Limit** (dBA) | Distance from Track (m) | Simulated 2030 (dBA) | Simulated 2060 (dBA) | Increment 2030 (dBA) | Increment 2060 (dBA) | Remarks |
|------------------|------------------|---------------|-------------------------|----------------------|----------------------|----------------------|----------------------|------------------|
| NS1 | 60.3 | 70 | 53 | 60.3 | 60.3 | 0.0 | 0.0 | Train in tunnel |
| NS2 | 67.0 | 72.1 | 17 | 67.0 | 67.0 | 0.0 | 0.0 | Train in tunnel |
| NS3 | 63.0 | 65 | 43 | 63.0 | 63.0 | 0.0 | 0.0 | Train in tunnel |
| NS4 | 72.1 | 74.8 | 16 | 74.9 | 77.8 | 2.8 | 5.7 | - |
| NS5 | 56.1 | 70 | 350 | 58.6 | 61.5 | 2.5 | 5.4 | Passing LMB |
| NS6 | 71.9 | 73.9 | 48 | 72.6 | 73.7 | 0.7 | 1.8 | Computed at 33 m |
| NS7 | 65.9 | 67.9 | 90 | 67.6 | 69.9 | 1.7 | 4.0 | - |
| NS8 | 48.0 | 65 | 68 | 67.4 | 72.3 | 19.4 | 24.3 | Train at station |
| NS9 | 52.2 | 65 | 2 | 69.8 | 74.6 | 17.6 | 22.4 | Computed at 25 m |
| NS10 | 49.9 | 65 | 30 | 76.6 | 81.5 | 26.7 | 31.6 | - |
| NS11 | 51.1 | 65 | 22 | 75.0 | 80.0 | 23.9 | 28.9 | - |

* L_{eq} from baseline monitoring

** Noise limit is derived from combination of Schedule 2, Schedule 3 and Schedule 5 of the 2007 DOE Noise Guidelines.

Comparing the simulated noise levels denoted in **Table 7-9** (labelled as “Simulated 2030” and “Simulated 2060”) with the limits specified under the DOE Noise Guidelines, the magnitude of noise level increments at the receptor locations can be gauged. In this table, receptors located in residential and noise sensitive areas, which are likely to experience sound levels higher than the DOE stipulated limits are labelled in **bold font style**. These are the critical areas where noise mitigating measures such as the installation of noise barriers are recommended. The predicted sound levels are computed at residential or noise sensitive areas located in the vicinity of the Project’s noise and vibration sampling stations (herewith re-designated as receptors), either closer to or farther from the HSR alignment as indicated in the columns labelled as “Distance from Track” or “Remark” in the same table, assuming that the measured L_{eq} can still reflect the baseline sound levels in those areas. The results of the computer simulation are also presented in detail in **Appendix 7F** according to state.

II. Noise from Road Traffic Flow

New road traffic flow may change noise propagation in the affected areas. In this case, the establishment of Sepang-Putrajaya Station may change the road layout around Kg. Dato' Abu Bakar Baginda and Kg. Sg. Merab Luar. Depending on the new traffic volume and pattern occupying the diverted routes, the noise level for the receivers within 25 m and 50 m of the site may reach a level higher level that is stipulated by the DOE Noise Guidelines, which can be a nuisance to the affected residential areas in Kg. Dato' Abu Bakar Baginda and Kg. Sg. Merab Luar.

III. Noise due to Activities at Station, Depots and Maintenance Base and Repair and Maintenance Work on Tracks

Noise generated due to activities performed at Sepang-Putrajaya Station and Light Depot and LMB as well as repair and maintenance works on the tracks involve use of heavy machinery and equipment at the site and/or its tracks. The repair works may also include repairs after any train derailment and collision events. Noise from heavy machinery and equipment such as generators, grinders and metal cutters at the site and at the tracks would increase the sound pressure levels from its existing ambient values. Depending on the type and number of machinery used in the work site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. However, the noise impact on these activities is minimal as trains normally reduce the speed when entering the station. In addition, the location of Light Depot and LMB in Serdang is far enough to cause any significant impact to the residents along Jalan UPM and noise sensitive receptors in UPM campus.

C) Negeri Sembilan

I. Noise from Movement of Trains at High Speed and Approaching / Leaving Station

Movement of trains at high speed will increase the sound pressure levels along and the sound waves propagate perpendicular to its pathway particularly when passing a certain area several times. Noise impact for affected areas in Negeri Sembilan is significant as the train speed is expected to reach its maximum operating speed of 320 km/h within Negeri

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Sembilan, except when approaching Seremban Station, which leads to significant noise impact.

In predicting noise impact due to train movement, noise modelling has been carried out over the HSR alignment in Negeri Sembilan based on methodology described above. Arising from the computer simulation, the predicted noise level increments deduced at selected receptors located adjacent to the HSR alignment are summarised in **Table 7-10**:

Table 7-10: Predicted Increment of Noise Levels at Selected Receptors in Negeri Sembilan

| Receptor Ref (a) | L_{eq} (dBA) | Limit* (dBA) | Distance from Track (m) | Simulated 2030 (dBA) | Simulated 2060 (dBA) | Increment 2030 (dBA) | Increment 2060 (dBA) | Remarks |
|------------------|----------------|--------------|-------------------------|----------------------|----------------------|----------------------|----------------------|---------|
| NN2 | 64.9 | 66.9 | 70 | 68.2 | 71.4 | 3.3 | 6.5 | - |
| NN3 | 57.3 | 60 | 348 | 59.5 | 62.1 | 2.2 | 4.8 | - |
| NN4 | 62.7 | 64.7 | 28 | 73.1 | 77.8 | 10.4 | 15.1 | - |
| NN5 | 67.5 | 69.5 | 84 | 70.8 | 74.1 | 3.3 | 6.6 | - |
| NN6 | 57.3 | 65 | 74 | 58.2 | 59.7 | 0.9 | 2.4 | - |
| NN7 | 55.9 | 65 | 105 | 65.6 | 70.2 | 9.7 | 14.3 | - |

* Noise limit is derived from combination of Schedule 2, Schedule 3 and Schedule 5 of the 2007 DOE Noise Guidelines.

Comparing the simulated noise levels denoted in **Table 7-10** (labelled as “Simulated 2030” and “Simulated 2060”) with the limits specified under the DOE Noise Guidelines, the magnitude of noise level increments at the receptor locations can be gauged. In this table, receptors located in residential and noise sensitive areas, which are likely to experience sound levels higher than the DOE stipulated limits are labelled in **bold font style**. These are the critical areas where noise mitigating measures such as the installation of noise barriers are recommended. The predicted sound levels are computed at residential or noise sensitive areas located in the vicinity of the Project’s noise and vibration sampling stations (herewith re-designated as receptors), either closer to or farther from the HSR alignment as indicated in the columns labelled as “Distance from Track” or “Remark” in the same table, assuming that the measured L_{eq} can still reflect the baseline sound levels in those areas. The results of the computer simulation are also presented in detail in **Appendix 7F** according to state.

II. Noise due to Activities at Station and Repair and Maintenance Work on Tracks

Noise generated due to activities performed at Seremban Station as well as repair and maintenance works on the tracks involve use of heavy machinery and equipment at the site and/or its tracks. The repair works may also include repairs after any train derailment and collision events. Noise from heavy machinery and equipment such as generators, grinders and metal cutters at the site and at the tracks would increase the sound pressure levels from its existing ambient values. Depending on the type and number of machinery used in the work site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. However, the noise impact on these activities is minimal as trains normally reduce the speed when entering the station.

D) Melaka

I. Noise from Movement of Trains at High Speed and Approaching / Leaving Station

Movement of trains at high speed will increase the sound pressure levels along and the sound waves propagate perpendicular to its pathway particularly when passing a certain area several times. Noise impact for affected areas in Melaka is significant as the train speed is expected to reach its maximum operating speed of 320 km/h within Melaka, except when approaching Melaka Station, which leads to significant noise impact.

Noise propagation simulation has been carried out over the HSR alignment in Melaka based on methodology described above. Arising from this numerical simulation, the predicted noise level increments deduced at selected receptors located adjacent to the HSR alignment stations are summarised in **Table 7-11**.

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Table 7-11: Predicted Increment of Noise Levels at Selected Receptors in Melaka

| Receptor Ref (a) | L_{eq}^* (dBA) | Limit** (dBA) | Distance from Track (m) | Simulated 2030 (dBA) | Simulated 2060 (dBA) | Increment 2030 (dBA) | Increment 2060 (dBA) | Remarks |
|------------------|------------------|---------------|-------------------------|----------------------|----------------------|----------------------|----------------------|------------------|
| NM1 | 51.9 | 60 | 36 | 83.0 | 87.9 | 31.1 | 36.0 | - |
| NM2 | 57.7 | 60 | 2 | 72.5 | 77.3 | 14.8 | 19.6 | Computed at 25 m |
| NM3 | 54.4 | 65 | 401 | 57.7 | 61.0 | 3.3 | 6.6 | Computed at 25 m |
| NM4 | 68.6 | 70.6 | 7 | 73.8 | 77.8 | 5.2 | 9.2 | Computed at 25 m |
| NM5 | 53.9 | 65 | 9 | 71.9 | 76.8 | 18.0 | 22.9 | Computed at 25 m |
| NM6 | 53.8 | 65 | 21 | 71.3 | 76.1 | 17.5 | 22.3 | Computed at 25 m |
| NM7 | 63.9 | 65.9 | 230 | 64.8 | 66.1 | 0.9 | 2.2 | Computed at 25 m |
| NM8 | 67.1 | 70 | 41 | 70.8 | 74.2 | 3.7 | 7.1 | Train at station |
| NM9 | 49.3 | 60 | 182 | 58.5 | 63.1 | 9.2 | 13.8 | - |
| NM10 | 47.5 | 60 | 86 | 66.6 | 71.5 | 19.1 | 24.0 | - |
| NM11 | 56.9 | 65 | 14 | 73.9 | 78.8 | 17.0 | 21.9 | - |
| NM12 | 66.0 | 68 | 31 | 74.5 | 78.9 | 8.5 | 12.9 | - |

* L_{eq} from baseline monitoring

** Noise limit is derived from combination of Schedule 2, Schedule 3 and Schedule 5 of the 2007 DOE Noise Guidelines.

Comparing the simulated noise levels denoted in **Table 7-11** (labelled as “Simulated 2030” and “Simulated 2060”) with the limits specified under the DOE Noise Guidelines, the magnitude of noise level increments at the receptor locations can be gauged. In this table, receptors located in residential and noise sensitive areas, which are likely to experience sound levels higher than the DOE stipulated limits are labelled in **bold font style**. These are the critical areas where noise mitigating measures such as the installation of noise barriers are recommended. The predicted sound levels are computed at residential or noise sensitive areas located in the vicinity of the Project’s noise and vibration sampling stations (herewith re-designated as receptors), either closer to or farther from the HSR Alignment as indicated in the columns labelled as “Distance from Track” or “Remark” in the same table, assuming

that the measured L_{eq} can still reflect the baseline sound levels in those areas. The results of the computer simulation are also presented in detail in **Appendix 7F** according to state.

II. Noise due to Activities at Station and Repair and Maintenance Work on Tracks

Noise generated due to activities performed at Melaka Station as well as repair and maintenance works on the tracks involve use of heavy machinery and equipment at the site and / or its tracks. The repair works may also include repairs after any train derailment and collision events. Noise from heavy machinery and equipment such as generators, grinders and metal cutters at the site and at the tracks would increase the sound pressure levels from its existing ambient values. Depending on the type and number of machinery used at the work site, the noise level for the receivers within 25 m and 50 m of the site are expected to reach maximum levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. However, the noise impact on these activities is minimal as trains normally reduce the speed when entering the station.

E) Johor

I. Noise from Movement of Trains at High Speed and Approaching / Leaving Stations

Movement of trains at high speed will increase the sound pressure levels along and the sound waves propagate perpendicular to its pathway particularly when passing a certain area several times. Noise impact for areas between Iskandar Puteri Station and Jurong East Station in Singapore is not as significant as the other States and other parts of Johor which is mainly due to the application of speed limit of 200 km/h between both destinations. However, from Iskandar Puteri Station towards Melaka border, train speed may reach its maximum operating speed of 320 km/h, which leads to significant noise impact.

In predicting noise impact due to train movement, noise modelling has been carried out over the HSR alignment in Johor based on methodology described above. Arising from this computer simulation, the predicted noise level increments deduced at selected receptors located adjacent to the HSR alignment are summarised in **Table 7-12**.

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Table 7-12: Predicted Increment of Noise Levels at Selected Receptors in Johor

| Receptor Ref (a) | L _{eq} * (dBA) | Limit** (dBA) | Distance from Track (m) | Simulated 2030 (dBA) | Simulated 2060 (dBA) | Increment 2030 (dBA) | Increment 2060 (dBA) | Remarks |
|------------------|-------------------------|---------------|-------------------------|----------------------|----------------------|----------------------|----------------------|------------------|
| NJ1 | 57.0 | 60 | 16 | 71.9 | 76.7 | 14.9 | 19.7 | Computed at 25 m |
| NJ2 | 52.1 | 65 | 26 | 74.2 | 79.2 | 22.1 | 27.1 | - |
| NJ3 | 51.1 | 70 | 8 | 73.5 | 78.5 | 22.4 | 27.4 | Train at station |
| NJ4 | 64.5 | 66.5 | 15 | 72.8 | 77.2 | 8.3 | 12.7 | Computed at 25 m |
| NJ5 | 58.3 | 60.3 | 52 | 71.4 | 76.2 | 13.1 | 17.9 | - |
| NJ6 | 61.4 | 63.4 | 58 | 69.7 | 74.2 | 8.3 | 12.8 | - |
| NJ7 | 57.4 | 60 | 128 | 63.5 | 67.6 | 6.1 | 10.2 | - |
| NJ8 | 46.0 | 70 | 12 | 75.0 | 79.9 | 29.0 | 33.9 | Train at station |
| NJ9 | 59.3 | 61.3 | 25 | 74.4 | 79.2 | 15.1 | 19.9 | - |
| NJ10 | 58.6 | 60.6 | 12 | 72.3 | 77.1 | 13.7 | 18.5 | Computed at 25 m |
| NJ11 | 63.8 | 65.8 | 48 | 70.9 | 75.1 | 7.1 | 11.3 | - |
| NJ12 | 57.0 | 70 | 2,340 | 57.0 | 57.1 | 0.0 | 0.1 | - |
| NJ13 | 64.0 | 66 | 31 | 72.2 | 76.6 | 8.2 | 12.6 | - |
| NJ14 | 66.8 | 68.8 | 85 | 68.7 | 71.1 | 1.9 | 4.3 | - |
| NJ15 | 48.2 | 60 | 65 | 69.5 | 74.4 | 21.3 | 26.2 | - |
| NJ16 | 52.2 | 75 | 1,840 | 52.4 | 52.9 | 0.2 | 0.7 | Quarry at 1.8 km |
| NJ17 | 53.3 | 60 | 275 | 59.1 | 63.2 | 5.8 | 9.9 | - |
| NJ18 | 50.7 | 65 | 101 | 66.4 | 71.3 | 15.7 | 20.6 | - |
| NJ19 | 49.1 | 60 | 3 | 59.7 | 64.4 | 10.6 | 15.3 | Train at station |
| NJ20 | 52.9 | 60 | 22 | 60.2 | 62.5 | 7.3 | 9.6 | Computed at 25 m |
| NJ21 | 47.8 | 75 | 870 | 50.0 | 52.6 | 2.2 | 4.8 | Passing HMB |

* L_{eq} from baseline monitoring

** Noise limit is derived from combination of Schedule 2, Schedule 3 and Schedule 5 of the 2007 DOE Noise Guidelines.

Comparing the simulated noise levels denoted in **Table 7-12** (labelled as “Simulated 2030” and “Simulated 2060”) with the limits specified under the DOE Noise Guidelines, the magnitude of noise level increments at the receptor locations can be gauged. In this table, receptors located in residential and noise sensitive areas, which are likely to experience sound levels higher than the DOE stipulated limits are labelled in **bold font style**. These are the critical areas where noise mitigating measures such as the installation of noise barriers are recommended. The predicted sound levels are computed at residential or noise sensitive areas located in the vicinity of the Project’s noise and vibration sampling stations (herewith re-designated as receptors), either closer to or farther from the HSR alignment as indicated in the columns labelled as “Distance from Track” or “Remark” in the same table, assuming that the measured L_{eq} can still reflect the baseline sound levels in those areas. The results of the computer simulation are also presented in detail in **Appendix 7F** according to state.

II. Noise from Road Traffic Flow

New road traffic flow may change noise propagation in the affected areas. In this case, the establishment of Batu Pahat Station may change the road layout around Taman Pura Kencana. This leads to certain recipients experiencing higher noise levels as the road is diverted closer to their locations in making way to Station and tracks. Depending on the new traffic volume and pattern occupying the diverted routes, the noise levels for the receivers within 25 m and 50 m of the site may reach a level higher level that is stipulated by the DOE Noise Guidelines, which can be a nuisance to the affected residents in Taman Pura Kencana.

III. Noise due to Activities at Stations, Depots and Maintenance Bases and Repair and Maintenance Work on Tracks

Noise generated due to activities performed at Muar, Batu Pahat and Iskandar Puteri Stations, HMB and Main Depot and LMB as well as repair and maintenance works on the tracks involve use of heavy machinery and equipment at the site and / or its tracks. The repair works may also include repairs after any train derailment and collision events. Noise from heavy machinery and equipment such as generators, grinders and metal cutters at the site and at the tracks would increase the sound pressure levels from its existing ambient values. Depending on the type and number of machinery used at the work site, the noise levels for the receivers within 25 m and 50 m of the site are expected to reach maximum

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levels of 82 dBA and 76 dBA, respectively, as indicated in **Table 7-4**. These activities can be a nuisance to nearby residential and noise sensitive areas, particularly in the vicinity of Batu Pahat Station and Main Depot and LMB where the nearest receptors are less than 200 m compared to the other Stations and HMB which has the nearest receptors at least 500 m or more.

7.4 VIBRATION IMPACTS

7.4.1 Construction Phase

The assessment and evaluation of vibration impacts are predicated on the potential activities that will be executed to construct the Project components. The list of these construction related activities that has potential vibration impacts are summarised in **Table 7-13**.

Table 7-13: Project Activities during construction phase that has potential vibration impacts

| Main Project Activities | Sub-Project Activities |
|---|---|
| Stations, Depots and Maintenance Bases | Land Clearing |
| | Demolition |
| | Earthworks |
| | Transportation of Materials / Equipment |
| | Piling |
| Tracks Work (At-grade, Elevated, Tunnel and Bridge) | Land Clearing |
| | Demolition |
| | Earthworks |
| | Transportation of Materials / Equipment |
| | Piling |
| | Tunnelling |

Particular activities associated with the construction of Stations, Depots, Maintenance Bases and tracks that could impose vibration impacts on nearby receptors include:

1. Land Clearing
2. Demolition
3. Earthworks
4. Transportation of Materials / Equipment
5. Piling
6. Tunnelling

The allowable vibration limits during the construction phase is specified by the DOE Vibration Guidelines in the form of limits for short term vibration as per **Table 7-14**.

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Table 7-14: Limits for Short Term Vibration during Construction Phase

| Type of Structure | Vibration Peak Velocity, mm/s (all frequencies) |
|---|--|
| Industrial buildings | 40 |
| Commercial buildings and dwelling | 15 |
| Vibration sensitive structure, including buildings under preservation order | 8 |

Piling involves inserting piles into underground to support the foundations of big and huge structures, while tunnelling involves making a large hole underground between two (2) tunnel portals by removing excavated materials. The impact on these activities depends on the geological underground profile of the areas along the HSR alignment. The receptors may have higher impact if the location of the receptors is in an area of hard bedrocks, such as granite and quartzite foundations. However, if the underground profile is among the materials that can absorb vibration such as alluvium, schists and limestones, the vibration impact to the nearby receptor is negligible or minimal. The predicted safe distance due to vibration from different piling activities measured at specific distances away from its position are listed in **Table 7-15** and the estimated PPV values for groundborne vibration from tunnelling activities are given in **Table 7-16**.

Table 7-15: Predicted minimum distance between piling operation and sensitive building.

| Building type (Vibration limit, PPV) | Piling Method | | | | | |
|---|--------------------|--|------|------------------------|------|------|
| | Press-in method | Impact hammer (stiff clay/ medium dense sand (kJ/blow) | | Vibrator (kJ/cycle) | | |
| | | 5 | 25 | 2 | 10 | 50 |
| Architectural merit (2 mm/s) | 3.5 m | 26.5 m | 59 m | 16 m | 36 m | 78 m |
| Residential area (4 mm/s) | 1.8 m | 13 m | 30 m | 8 m | 18 m | 39 m |
| Light commercial (10 mm/s) | 0.7 m | 5 m | 12 m | 3.1 m | 7 m | 16 m |
| Heavy industrial (15 mm/s) | 0.5 m | 3.6 m | 8 | 2.1 m | 5 m | 10 m |

Source: White, D., Finlay, F., Bolton, M. and Bearss, G. (2002), Cambridge University Engineering Department

Table 7-16: Estimated vibration level (PPV), from tunneling activities

| Distance (m) from tunneling activity | Vibration peak velocity, (mm/s) |
|--------------------------------------|---------------------------------|
| 10 | 9.02 |
| 20 | 3.66 |
| 30 | 2.16 |

Source: BS 5228-2:2009 (Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration)

In general, residential areas and vibration sensitive areas located less than 30 m or less than 50 m, respectively, from the alignment could be adversely impacted. In addition, impact from piling and tunnelling activities could be extended to 100 m, depending on the geological profile of foundation of the area. Vibration related impacts that can be imposed on surrounding receptors by the above-mentioned list of project activities are described herewith according to states.

In the absence of detailed soil information along the HSR alignment, prediction ground borne vibration impacts and propagation to surrounding receptors will be inaccurate and cannot be reliably predicted. Therefore, a more detailed vibration impacts analysis will be performed by the PDP during the Detailed Design stage of the Project, the details of which will be submitted to the DOE.

A) FT. Kuala Lumpur

Construction activities may cause adverse impacts to be imposed on nearby residents and vibration sensitive areas located adjacent to the HSR alignment where the tracks and station are to be constructed. For piling and tunnelling activities, the potential impacts imposed on the following habitats could be adverse in areas of granite foundations and high-rise buildings, i.e., around Kg. Baru Salak Selatan (VK4); Desa Petaling (VK5) and Kg. Malaysia Tambahan (VK6).

Other construction activities, such as land clearing, demolition and transportation of machinery and excavated materials may cause adverse impacts to be imposed on nearby residents and vibration sensitive areas located adjacent to the HSR alignment where the tracks and station are to be constructed since these activities may increase ambient ground vibration which may be passed to nearby receptors, particularly high density populations,

CHAPTER 7: EVALUATION OF IMPACTS

education institutions, training centres and areas with large buildings close to the HSR alignment. Removal of excavated materials from tunnel construction may increase frequency of trucks used to transport the materials in areas around the tunnel portals. Based on these conditions and taking into consideration the current measured vibration levels at specific receptors located near Bandar Malaysia Station (VK1), Jalan JKR Salak Selatan (VK2) and Kg. Baru Salak Selatan (VK3), where increased ground vibration impacts could be significant.

I. Vibration from Land Preparation, Earthworks and Demolition Activities

Land preparation and earthworks for construction of Stations as well as construction of tracks involve the use of many heavy machinery and vehicles including bulldozers, excavators, graders and trucks, which may cause ambient ground vibration to increase. Demolition of old building and structures using excavators and/or bulldozers would also generate ground vibration in addition to operation of the existing machinery and vehicles. These activities can cause disturbance and annoyance to residents living within 100 m from the construction sites in Bandar Malaysia Station such as Taman Desa Seputeh and along the HSR alignment at Jalan JKR Salak Selatan and Kg. Baru Salak Selatan.

II. Vibration induced by Vehicle Movements and Transportation of Materials and Equipment

Vehicle movement and transportation of construction materials and equipment to the site will involve the use of noisy vehicles such as trucks, which may cause ambient ground vibration to increase. In addition, construction of tunnel for part of the HSR alignment from Kg. Baru Salak Selatan and Serdang, produces excavated materials that need to be transported out from the excavated sites. Depending on the type and number of vehicle used, the vehicle movement and the loads carried by the vehicle may increase the ground vibration if the receiving buildings and structures are located less than 30 m from the vehicle pathway. These activities can cause disturbance and annoyance to within 30-50 m from the access roads and states and federal routes used by the trucks carrying machinery and materials from and to the construction sites in Bandar Malaysia Station and along the HSR alignment at Jalan JKR Salak Selatan as well as around the tunnel portal at Kg. Baru Salak Selatan.

III. Vibration from Piling Activities

Vibration generated by piling activities are impulsive in nature and are relatively more annoying than steady-state noise and vibration. Ground vibration signal can be dampened and absorbed by certain soil profiles such as schists and limestones, which are the dominant geological profile along the HSR alignment. These activities can cause disturbance and annoyance to nearby residents and impact vibration sensitive structures especially for part of alignment located in granite based foundation and bedrocks such as in some parts of Kuala Lumpur, namely in Salak Selatan and Sri Petaling. Vibration impact from piling may also be significant for piling locations that are close residential areas, where the HSR alignment traverses high density populations and vibration sensitive structures and buildings such as near Bandar Malaysia Station.

IV. Vibration from Tunnelling

Vibration generated due to tunnelling activities for Tunnel along the HSR alignment involve use of TBM for construction of tunnel from Bandar Malaysia to Serdang. Hence, this impact may be significant for areas having granite foundation around Salak Selatan and Sri Petaling and for areas of large or high-rise buildings where underground Tunnel are to be constructed such as apartments in Kg. Malaysia Tambahan and near Terminal Bersepadu Selatan in Bandar Tasik Selatan.

B) Selangor

Construction activities may cause adverse impacts to be imposed on nearby residents and vibration sensitive areas located adjacent to the HSR alignment where the tracks, Stations, Depots and Maintenance Bases are to be constructed. For piling and tunnelling activities, the potential impacts imposed on the following habitats could be adverse in areas of granite foundations and high-rise buildings, i.e., around South City Condo (VS2); Univ360 Place (VS3); UPM campus (near VS4).

Other construction activities, such as land clearing, demolition and transportation of machinery and excavated materials may cause adverse impacts to be imposed on nearby residents and vibration sensitive areas located adjacent to the HSR alignment where the tracks, Stations, Depots and Maintenance Bases are to be constructed since these activities

may increase ambient ground vibration which may be passed to nearby receptors, particularly high density populations, education institutions, training centres and areas with large buildings close to the HSR alignment. Removal of excavated materials from tunnel construction may increase intensity of trucks used to transport the excavated materials in areas around the tunnel portals. Based on these conditions and taking into consideration the current measured vibration levels at specific receptors located near UPM campus (near VS3); UNITEN campus and training centres along Jalan Ayer Hitam (VS5), Kg. Dato' Abu Bakar Baginda (VS6), Persiaran Vista, Sepang (VS8) and Desa Bestari, Sepang (VS9), where increased ground vibration impacts could be significant.

I. Vibration from Land Preparation, Earthworks and Demolition Activities

Land preparation and earthworks for construction of Stations, Depots and Maintenance Base as well as construction of tracks involve the use of many heavy machinery and vehicles including bulldozers, excavators, graders and trucks, which may cause ambient ground vibration to increase. Demolition of old building and structures using excavators and/or bulldozers would also generate ground vibration in addition to operation of the existing machinery and vehicles. These activities can cause disturbance and annoyance to residents living within 30-50 m from the construction sites at Sepang-Putrajaya Station and along Jalan UPM, Kg. Dato' Abu Bakar Baginda, Kg. Sg. Merab Hulu, Kg. Jenderam Hulu, Kg. Bukit Piatu and Desa Bestari, Sepang, as well as at higher education institutions and training centres along Jalan UPM, Jalan Sg. Besi and Jalan Ayer Hitam.

II. Vibration induced by Vehicle Movements and Transportation of Materials and Equipment

Vehicle movement and transportation of construction materials and equipment to the site will involve the use of noisy vehicles such as trucks, which may cause ambient ground vibration to increase. In addition, construction of tunnels at two (2) locations, namely near Puncak Pinggiran Putra and Bukit Unggul Golf and Country, produces excavated materials that need to be transported out from the excavated sites. Depending on the type and number of vehicle used, the vehicle movement and the loads carried by the vehicle may increase the ground vibration if the receiving buildings and structures are located less than 30 m from the vehicle pathway. These activities can cause disturbance and annoyance to residents living within 30-50 m from the access roads and states and federal routes used by the trucks

carrying machinery and materials from and to the construction sites at Sepang-Putrajaya Station and along Jalan UPM, Jalan Sg. Besi and Jalan Ayer Hitam, as well as at Kg. Dato' Abu Bakar Baginda, Kg. Sg. Merab Luar, Kg. Sg. Merab Hulu, Kg. Jenderam Hulu, Kg. Bukit Piatu, Bandar Salak Tinggi and Desa Bestari, Sepang.

III. Vibration from Piling Activities

Vibration generated by piling activities are impulsive in nature and are relatively more annoying than steady-state noise and vibration. Ground vibration signal can be dampened and absorbed by certain soil profiles such as schists and limestones profiles, which are the dominant geological profile along the HSR alignment in Selangor. However, these activities may still cause disturbance to nearby residents and impact vibration sensitive structures especially that are close to medium- and high-density populations and vibration sensitive structures and buildings such as near higher education institutions (UPM and UNITEN), training centres along Jalan Ayer Hitam, Kg. Dato' Abu Bakar Baginda, Persiaran Vista and Desa Bestari, Sepang.

IV. Vibration from Tunnelling

Vibration generated due to tunnelling activities for tunnels along the HSR alignment involve use of TBM for tunnel location from Bandar Malaysia to Serdang in Kuala Lumpur and Selangor and NATM for two tunnels at Puncak Pinggiran Putra and Bukit Unggul Golf and Country. However, the geological profile for most of the affected areas are covered with either alluvium and peat soil profiles, that can absorb most of the ground vibration signal generate from the sites. Hence, this impact is negligible except for areas having granite foundation around Salak Selatan and Bandar Tasik Selatan (in FT. Kuala Lumpur). In parts of tunnels where NATM is used, blasting is part of the construction process in NATM which may cause vibration signals propagated to the structures and recipients on the ground. This may cause nuisance to recipients located or residents living on shallow tunnels and near tunnel portals in Puncak Pinggiran Putra, Bukit Unggul Golf and Country, Kg. Sg. Merab Hulu, Kg. Bukit Piatu and Bandar Salak Tinggi.

C) Negeri Sembilan

Construction activities may cause adverse impacts to be imposed on nearby residents and vibration sensitive areas located adjacent to the HSR alignment where the tracks and stations are to be constructed. For piling and tunnelling activities, the potential impacts could be adverse in areas of granite foundations and high-rise buildings, i.e., Seremban Station (VN1), Taman Gadong Putra, Labu (VN2), along Seremban-Bukit Nenas Highway (VN3) and Felda Seri Sendayan (VK4).

Other construction activities, such as land clearing, demolition and transportation of machinery and excavated materials may cause adverse impacts to be imposed on nearby residents and vibration sensitive areas located adjacent to the HSR alignment where the tracks and stations are to be constructed since these activities may increase ambient ground vibration which may be passed to nearby receptors, particularly high-density populations, education institutions, training centres and areas with large buildings close to the HSR alignment. Removal of excavated materials from tunnel construction may increase intensity of trucks used to transport the materials in areas around the tunnel portals. Based on these conditions and taking into consideration the current measured vibration levels at specific receptors located near to the proposed alignment, increased ground vibration impacts could be significant in Felda Seri Sendayan (VN4).

I. Vibration from Land Preparation, Earthworks and Demolition Activities

Land preparation and earthworks for construction of stations as well as construction of tracks involve the use of many heavy machinery and vehicles including bulldozers, excavators, graders and trucks, which may cause ambient ground vibration to increase. Demolition of old building and structures using excavators and/or bulldozers would also generate ground vibration in addition to operation of the existing machinery and vehicles. These activities can cause disturbance and annoyance to residents living within 30-50 m from the construction sites at Desa Cempaka and Kota Seriemas in Nilai, Taman Gadong Putra and Taman Cermat Utama in Labu, Felda Sri Sendayan and Taman Sg. Ujong, Siliau.

II. Vibration induced by Vehicle Movements and Transportation of Materials and Equipment

Vehicle movement and transportation of construction materials and equipment to the site will involve the use of noisy vehicles such as trucks, which may cause ambient ground vibration to increase. In addition, construction of two tunnels near Kg. Baharu Jimah to Bandar Spring Hill and Bandar Spring Hill to Ladang Salak, Sime Darby Plantation, produces excavated materials that need to be transported out from the excavated sites. Depending on the type and number of vehicle used, the vehicle movement and the loads carried by the vehicle may increase the ground vibration if the receiving buildings and structures are located less than 30 m from the vehicle pathway. These activities can cause disturbance and annoyance to receptors along Federal Route 53 and State Route N6 (Jalan Siliau) which may be used by the trucks carrying machinery and materials from and to the construction sites.

III. Vibration from Piling Activities

Vibration generated by piling activities are impulsive in nature and are relatively more annoying than steady-state noise and vibration. Ground vibration signal can be dampened and absorbed by certain soil profiles such as schists and limestones, which are the dominant geological profile along the HSR alignment. These activities can cause disturbance and annoyance to nearby residents and impact vibration sensitive structures especially for part of alignment located in granite based foundation and bedrocks such as in some parts of in Negeri Sembilan, namely in Labu and Sendayan. Impact from piling may also be significant for piling locations that are close residential areas, where the HSR alignment transverses medium- and high-density populations and vibration sensitive structures and buildings such as in Desa Cempaka and Kota Seriemas in Nilai, Taman Gadong Putra and Taman Cermat Utama in Labu, Felda Sri Sendayan and Taman Sg. Ujong, Siliau.

IV. Vibration from Tunnelling

Vibration generated due to tunnelling activities for tunnels along the HSR alignment involve application of NATM near Sendayan and Siliau. Since NATM involves blasting as part of the construction process, this may generate vibration signals propagated to the structures and recipients on the ground and may cause nuisance to recipients located or residents living on

shallow tunnels and near tunnel portals near Kg. Baharu Jimah, Bandar Spring Hill and Ladang Salak.

D) Melaka

Construction activities may cause adverse impacts to be imposed on nearby residents and vibration sensitive areas located adjacent to the HSR alignment where the tracks and stations are to be constructed. For piling and tunnelling activities, the potential impacts could be adverse in the areas of granite foundations in Bemban, such as near Pusat Rehabilitasi PERKESO Melaka (VM9) and Taman Bemban Baru (VM10).

Other construction activities, such as land clearing, demolition and transportation of machinery and excavated materials may cause adverse impacts to be imposed on nearby residents and vibration sensitive areas located adjacent to the HSR alignment where the tracks and stations are to be constructed since these activities may increase ambient ground vibration which may be passed to nearby receptors, particularly high-density populations, education institutions, training centres and areas with large buildings close to the HSR alignment. Based on these conditions and taking into consideration the current measured vibration levels at specific receptors located near to the HSR alignment, increased ground vibration impacts could be significant on the receptors at IKBN Alor Gajah (VM1), Taman Paya Rumput Indah (VM4), 1 Krubong Residence (VM5), Pusat Rehabilitasi PERKESO Melaka (VM9) and Taman Bemban Baru (VM10).

I. Vibration from Land Preparation, Earthworks and Demolition Activities

Land preparation and earthworks for construction of Stations as well as construction of tracks involve the use of many heavy machinery and vehicles including bulldozers, excavators, graders and trucks, which may cause ambient ground vibration to increase. Demolition of old building and structures using excavators and/or bulldozers would also generate ground vibration in addition to operation of the existing machinery and vehicles. These activities can cause disturbance and annoyance to residents living within 30-50 m from the construction sites, such as in Masjid Tanah, Taman Paya Rumput Indah, 1 Krubong Residence, Durian Tunggal, Kg. Ulu Duyung, Taman Bemban Jaya Taman Bemban Baru and Kg. Bemban, as well as in vibration sensitive areas, namely Kolej Yayasan Saad and Pusat Rehabilitasi PERKESO Melaka.

II. Vibration induced by Vehicle Movements and Transportation of Materials and Equipment

Vehicle movement and transportation of construction materials and equipment to the site will involve the use of noisy vehicles such as trucks, which may cause ambient ground vibration to increase. Depending on the type and number of vehicle used, the vehicle movement and the loads carried by the vehicle may increase the ground vibration if the receiving buildings and structures are located less than 30 m from the vehicle pathway. These activities can cause disturbance and annoyance to within 30-50 m from the access roads and states and federal routes used by the trucks carrying machinery and materials from and to the construction sites near Masjid Tanah, Taman Paya Rumput Indah, 1 Krubong Residence, Durian Tunggal, Kg. Ulu Duyung, Taman Bemban Jaya, Taman Bemban Baru and Kg. Bemban, as well as near vibration sensitive areas, namely Kolej Yayasan Saad and Pusat Rehabilitasi PERKESO Melaka.

III. Vibration from Piling Activities

Vibration generated by piling activities are impulsive in nature and are relatively more annoying than steady-state noise and vibration. Ground vibration signal can be dampened and absorbed by certain soil profiles such as schists and limestones, which are the dominant geological profile along the HSR alignment. These activities can cause disturbance and annoyance to nearby residents and impact vibration sensitive structures especially for part of alignment located in granite based foundation and bedrocks such as around Bemban. Impact from piling may also be significant for piling locations that are close residential areas, where the HSR alignment transverses medium- and high-density populations and vibration sensitive structures and buildings such as Kg. Ulu Duyung, Kg. Bemban, Taman Bemban Jaya, Taman Bemban Baru, Kolej Yayasan Saad and Pusat Rehabilitasi PERKESO Melaka.

E) Johor

Construction activities may cause adverse impacts to be imposed on nearby residents and vibration sensitive areas located adjacent to the HSR alignment where the tracks, stations, depots and maintenance bases are to be constructed. Other construction activities, such as land clearing, demolition and transportation of machinery and excavated materials may

cause adverse impacts to be imposed on nearby residents and vibration sensitive areas located adjacent to the HSR alignment where the tracks, stations, depots and maintenance bases are to be constructed since these activities may increase ambient ground vibration which may be passed to nearby receptors, particularly high-density populations, education institutions, training centres and areas with large buildings close to the HSR alignment.

Removal of excavated materials from tunnel construction may increase intensity of trucks used to transport the materials in areas around the tunnel portals. Based on these conditions and taking into consideration the current measured vibration levels at specific receptors located near to the HSR alignment, increased ground vibration impacts could be significant on the receptors at SK Pekan Pagoh (VJ4), at SMK Dato' Ibrahim Majid, Simpang Renggam (VJ7), near Pertubuhan Kebajikan Warga Emas Pontian (VJ8) and at SK Tanjung Kupang (VJ12).

I. Vibration from Land Preparation, Earthworks and Demolition Activities

Land preparation and earthworks for construction of stations, depots and maintenance base as well as construction of tracks involve the use of many heavy machinery and vehicles including bulldozers, excavators, graders and trucks, which may cause ambient ground vibration to increase. Demolition of old building and structures using excavators and/or bulldozers would also generate ground vibration in addition to operation of the existing machinery and vehicles. These activities can cause disturbance to nearby residential and vibration sensitive areas in Bukit Gambir, Panchor, Pagoh, Parit Yaani, Parit Sulong, Simpang Renggam, Pekan Nenas, Gelang Patah and Tanjung Kupang, that are located within 30-50 m from the construction sites.

II. Vibration induced by Vehicle Movements and Transportation of Materials and Equipment

Vehicle movement and transportation of construction materials and equipment to the site will involve the use of noisy vehicles such as trucks, which may cause ambient ground vibration to increase. In addition, construction of tunnels at Bukit Naning in Johor, produces excavated materials that need to be transported out from the excavated sites. Depending on the type and number of vehicle used, the vehicle movement and the loads carried by the vehicle may increase the ground vibration if the receiving buildings and structures are located less than

30 m from the vehicle pathway. These activities can cause disturbance and annoyance to residents living within 30-50 m from the access roads and states and federal routes in Bukit Gambir, Panchor, Pagoh, Parit Yaani, Parit Sulong, Simpang Renggam, Pekan Nenas, Gelang Patah and Tanjung Kupang, that are to be used by the trucks carrying machinery and materials from and to the construction sites.

III. Vibration from Piling Activities

Vibration generated by piling activities are impulsive in nature and are relatively more annoying than steady-state noise and vibration. Ground vibration signal can be dampened and absorbed by certain soil profiles such as alluvium, limestones and peat soil profiles, which are the dominant geological profile along the HSR alignment. However, impact from piling may also be significant for piling locations that are close residential areas, where the HSR alignment transverses medium- and high-density populations such as near Taman Pura Kencana which is close to the site for Batu Pahat Station, as well as several vibration sensitive buildings such as SK Pekan Pagoh, SMK Dato' Ibrahim Majid in Simpang Renggam, Pertubuhan Kebajikan Warga Emas Pontian in Pekan Nenas which is close to Main Depot and LMB and SK Tanjung Kupang.

IV. Vibration from Tunnelling

Vibration generated due to tunnelling activities for tunnels along the HSR alignment involve application of NATM for construction of two (2) tunnels near Bukit Naning. As NATM employs blasting as part of the construction process, it may cause vibration signals propagated to the structures and recipients on the ground. This may cause nuisance to residents in Bukit Naning, Pagoh. However, considering the soil profile of the area which can absorb ground vibration and with the nearest residents is more than 1.2 km away from the construction site, the impact is negligible.

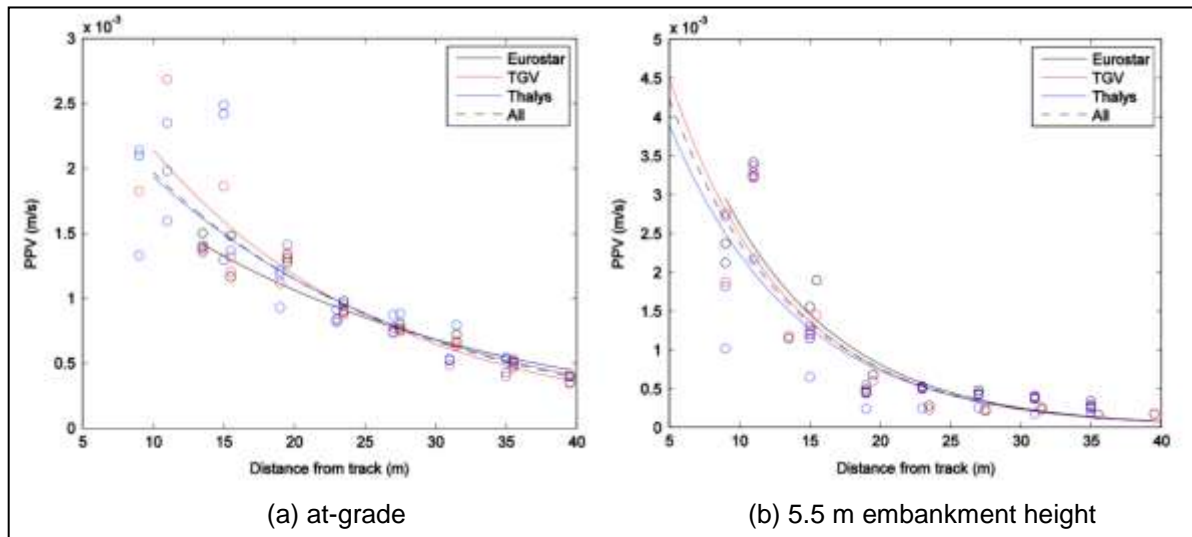
7.4.2 Operational Phase

The main activities that will be carried out by the Project Proponent during the operational phase that have vibration impacts are listed in **Table 7-17**:

Table 7-17: Project Activities during operational phase that has potential vibration impacts

| Main Project Activities | Sub-Project Activities |
|---|--|
| Stations, Depots and Maintenance Bases | Movement of Trains |
| | Stations / Depots / Maintenance Bases operational activities |
| Tracks Work (At-grade, Elevated, Tunnel and Bridge) | Movement of Trains at High Speed |
| | Repair and Maintenance Works on Tracks |

During operations, vibration is generated from the trains due to its high speed movement, which may be more significant when their operating frequency and speed increases and when the trains travels through a smaller radius curvature. As an indication, the kind vibration level to be anticipated during operation can be referred to a field testing undertaken by Connolly, et al. (2014) on the Belgian high speed rail network when they investigated vibration propagation characteristics of three different train types, namely the Eurostar, TGV and Thalys services. **Figure 7-46** shows the PPV level for train at-grade condition are still lower than 3 mm/s and the PPV levels for a 5.5 m high embankment condition at 13 m from the track are less than 3 mm/s, which conform with the limits stipulated by the DOE guidelines.



(Source : Connolly, D.P., Kouroussis, G., Woodward, P.K., Alves Costa, P., Verlinden, O., Forde, M.C. (2014) Field testing and analysis of high speed rail vibrations, *Soil Dynamics and Earthquake Engineering*, **67**:102-118.

Figure 7-46: PPV levels for various train types on at grade structure

Apart from trains operation, vibration can be generated from associated activities such as repair and maintenance works that are required to attend to train derailment or collision events occur, which require deployment and the operation of heavy machinery and equipment. The intensity of vibration impacts transmitted to surrounding receptors due to the Project activities depends on the relative distance separating the receptors from the train. Baseline vibration levels and their tone characteristics will influence the degree of annoyance felt by humans and animals alike.

Particular activities associated with the operation of trains, stations, depots and maintenance bases that could impose noise and vibration impacts on nearby receptors include:

1. Movement of Trains
2. Stations / Depots / Maintenance Bases operational activities
3. Repair and Maintenance Works on Tracks

These activities have the potential to induce adverse noise impacts on nearby residents, and noise sensitive areas, located near to the HSR alignment where the tracks will be placed; especially for those receptors located 30-50 m from the tracks, given that the existing vibration originating from other sources in the surrounding area such as road traffic is

relatively low. The anticipated increase in sound levels at potential receptors is discussed in the following narrative based on states.

These activities have the potential to induce adverse vibration impacts on nearby residents, and vibration sensitive areas, located near to the HSR alignment where the tracks will be placed; especially for those receptors located 30-50 m from the tracks, given that the existing vibration originating from other sources in the surrounding area such as road traffic is relatively low. The anticipated increase in sound levels at potential receptors is discussed in the following narrative based on states.

A) FT. Kuala Lumpur

I. Vibration from Movement of Trains at High Speed and Approaching / Leaving Station

During the operational phase, movement of high speed trains generate additional vibration from the train to the tracks. The vibration generated by train movement and contact between wheel and rail can be more dominant at higher speed and track curvature at smaller radius. This will be added to the ambient ground vibration level. If not isolated properly via sleepers or elevated structure, it could propagate to and cause disturbance and annoyance to the nearest recipients, i.e., residential areas along Jalan JKR Salak Selatan and at Kg. Baru Salak Selatan.

II. Vibration due to Activities at Station and Repair and Maintenance Work on Tracks

Vibration generated due to activities performed at Bandar Malaysia Station as well as repair and maintenance works on the tracks involve use of heavy machinery and equipment at the site and/or its tracks. This includes repair required in the event of train derailment and collision. Impulsive activities may generate forced vibration which may add to the ambient ground vibration. These activities can be a nuisance to nearby residential and noise sensitive areas, such as to residents in Taman Desa Seputeh which is about 200-300 m from Bandar Malaysia Station. However, if the vibration signal is properly isolated via sleepers or elevated structure, it could be prevented from propagate to and cause disturbance to the receptors in the residential areas and business properties.

B) Selangor / FT. Putrajaya

I. Vibration from Movement of Trains at High Speed and Approaching / Leaving Station

During the operational phase, movement of high speed trains generate additional vibration from the train to the tracks. The vibration generated by train movement and contact between wheel and rail can be more dominant at higher speed and track curvature at smaller radius. This will be added to the ambient ground vibration level. If not isolated properly via sleepers or elevated structure, it could propagate to and cause disturbance and annoyance to the nearest recipients, i.e., residential areas and business community along Jalan UPM, Kg. Dato' Abu Bakar Baginda and Desa Bestari, Sepang as well as at higher education institutions and training centres along Jalan UPM, Jalan Sg. Besi and Jalan Ayer Hitam.

II. Vibration due to Activities at Station, Depot and Maintenance Base and Repair and Maintenance Work on Tracks

Vibration generated due to activities performed at the Station, Depot and Maintenance Base as well as repair and maintenance works on the tracks involve use of heavy machinery and equipment at the site and/or its tracks. This includes repair required in the event of train derailment and collision. Impulsive activities may generate forced vibration which may add to the ambient ground vibration. These activities can be a nuisance to nearby residential and noise sensitive areas, particularly in the vicinity of Sepang-Putrajaya Station and Light Depot and LMB. However, if the vibration signal is properly isolated via sleepers or elevated structure, it could be prevented from propagate to and cause disturbance to the receptors in the residential areas and business properties.

C) Negeri Sembilan

I. Vibration from Movement of Trains at High Speed and Approaching / Leaving Station

During the operational phase, movement of high speed trains generate additional vibration from the train to the tracks. The vibration generated by train movement and contact between wheel and rail can be more dominant at higher speed and track curvature at smaller radius.

This will be added to the ambient ground vibration level. If not isolated properly via sleepers or elevated structure, it could propagate to and cause disturbance and annoyance to the nearest recipients, i.e., residential areas and business community in Desa Cempaka and Kota Seriemas in Nilai, Taman Gadong Putra and Taman Cermat Utama in Labu and Felda Sri Sendayan.

II. Vibration due to Activities at Station and Repair and Maintenance Work on Tracks

Vibration generated due to activities performed at Seremban Station as well as repair and maintenance works on the tracks involve use of heavy machinery and equipment at the site and/or its tracks. This includes repair required in the event of train derailment and collision. Impulsive activities may generate forced vibration which may add to the ambient ground vibration. As Seremban Station is situated on a granite foundation, vibration signals generated from the station may be propagated to nearby receptors. However, since the nearest receptor is 800 m away, the vibration impact from station activities is minimal.

D) Melaka

I. Vibration from Movement of Trains at High Speed and Approaching / Leaving Station

During the operational phase, movement of high speed trains generate additional vibration from the train to the tracks. The vibration generated by train movement and contact between wheel and rail can be more dominant at higher speed and track curvature at smaller radius. This will be added to the ambient ground vibration level. If not isolated properly via sleepers or Elevated Structure, it could propagate to and cause disturbance and annoyance to the nearest recipients, i.e., residential areas and business community in Masjid Tanah, Taman Paya Rumput Indah, 1Krubong Residence, Durian Tunggal, Kg. Ulu Duyung, Taman Bemban Jaya Taman Bemban Baru and Kg. Bemban, as well as in vibration sensitive receptors in IKBN Alor Gajah and Pusat Rehabilitasi PERKESO Melaka.

II. Vibration due to Activities at Station and Repair and Maintenance Work on Tracks

Vibration generated due to activities performed at Melaka Station as well as repair and maintenance works on the tracks involve use of heavy machinery and equipment at the site and/or its tracks. This includes repair required in the event of train derailment and collision. Impulsive activities may generate forced vibration which may add to the ambient ground vibration. These activities can be a nuisance to nearby residential and noise sensitive areas, particularly in the vicinity of Melaka Station. However, if the vibration signal is properly isolated via sleepers or Elevated Structure, it could be prevented from propagate to and cause disturbance to the nearest recipients, i.e., residential areas and business community such as INB Resort Hotel Ayer Keroh located about 100 m from the Melaka Station.

E) Johor

I. Vibration from Movement of Trains at High Speed and Approaching / Leaving Stations

During the operational phase, movement of high speed trains generate additional vibration from the train to the tracks. The vibration generated by train movement and contact between wheel and rail can be more dominant at higher speed and track curvature at smaller radius. This will be added to the ambient ground vibration level. If not isolated properly via sleepers or Elevated Structure, it could propagate to and cause disturbance and annoyance to the nearest recipients, i.e., residential areas and business community in Bukit Gambir, Panchor, Pagoh, Parit Yaani, Parit Sulong, Simpang Renggam, Pekan Nenas, Gelang Patah and Tanjung Kupang.

II. Vibration due to Activities at Stations, Depots and Maintenance Bases and Repair and Maintenance Work on Tracks

Vibration generated due to activities performed at Muar, Batu Pahat and Iskandar Puteri Stations, HMB and Main Depot and LMB as well as repair and maintenance works on the tracks involve use of heavy machinery and equipment at the site and/or its tracks. This includes repair required in the event of train derailment and collision. Many of these facilities are situated by soil profiles that are able to absorb ground vibration such as alluvium,

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limestones and peat soil profiles. These types of ground profile can absorb most of the ground vibration signal generate from the project site. Hence, the impact is minimal except at Batu Pahat Station and Main Depot and LMB which are respectively close to residential areas (Taman Pura Kencana) and sensitive receptors (Pertubuhan Kebajikan Warga Emas Pontian). However, if the vibration signal is properly isolated via sleepers or Elevated Structure, it could be prevented from propagate to and cause disturbance to these receptors.

7.5 WASTE MANAGEMENT IMPACTS

Waste arisings induced by Project activities can occur during both the construction and operation phases; especially during the construction Phase. The type and quantities of wastes that can be generated have been summarized in **Table 7-16 to 7-21**. They require appropriate means of disposal without incurring adverse environmental impacts. Potential impacts that can occur with waste disposals are described herewith.

7.5.1 Construction Phase

7.5.1.1 Introduction

Site preparation followed by earthworks operations for this Project shall have the ability to exert significant impacts on the environment as well as on human habitats. Wastes created by these two (2) main activities have been identified, and their potential for inducing environmental impacts is described.

Site clearing operations include removing from the HSR alignment all standing and ground based vegetation, a layer of organic surficial soil layer; and any structures that are present (e.g. buildings).

The disposal strategy proposed is based upon the waste management principle of reducing the amount of waste requiring final disposal through the development of outline plans for waste avoidance, material re-use, and recycling.

The overall objectives for the waste management assessment are summarized below:

- assess the construction activities involved for the proposed works and determine the type, nature and where possible estimate the volume and weight of waste that can be generated;
- identify any potential environmental impacts from the generation of waste associated with the works;

- categorise waste materials where practical, i.e. suitability for re-use/recycling, disposal to public filling areas, disposal to landfill and any pre-treatment requirements prior to disposal
- recommend appropriate waste management options (including waste minimization on-site, re-use or recycling opportunities and off-site disposal options);
- identify site management/mitigation measures that should be implemented to minimise any potential adverse impacts from the generation, handling, storage and disposal of waste, in accordance with the current legislative and administrative requirements.

Excavated materials and residual wastes may give rise to impacts during their handling, temporary stockpiling, or storage on site, transportation and final disposal. In order to determine the most appropriate methods of treatment, handling and disposal, it is important to comprehend the nature and composition of wastes produced; in particular whether the waste materials are inert, putrescible or contaminated.

7.5.1.2 Nature and Type of Waste Materials

Wastes which will be generated during the construction phase include the following:

- (i) Vegetation and demolition waste from site clearance;
- (ii) Excavated materials from earthworks (e.g. cuttings, pile foundations, regrading works);
- (iii) General construction waste (e.g. wood, scrap metal, concrete);
- (iv) Chemical wastes generated by general site practices (e.g. vehicle and plant maintenance/servicing); and
- (vi) Municipal wastes generated by site workers.

The main sources of solid wastes and construction wastes from the HSR alignment are as follows:

- 1) Centralized Labour Quarters (CLQ) – mainly domestic waste, packaging, containers, and domestic waste/rubbish.
- 2) Fabrication yard – scrap metals, machinery parts, used tires, containers, and packaging.

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- 3) Equipment yard – machinery parts, used tires, containers, and packaging
- 4) Ancillary facilities (concrete batching plant, asphalt plant, satellite offices) – excess bitumen, cement mix, and containers.
- 5) Work site – wood, wires, steel, concrete, old asphalt, excess soil, sand, and domestic waste/rubbish
- 6) Subcontractor's facilities - mainly domestic waste, packaging, and containers.

A table summarizing the categories of wastes during construction is summarized below:

Table 7-18: Types of Waste during Construction Phase

| Category of Waste | Sources of Waste | Type of Wastes |
|----------------------------|---|---|
| Construction Waste | <ul style="list-style-type: none"> • Station, yard, depot construction • Railway track construction • Tunnel construction • Elevated structure construction | <ul style="list-style-type: none"> • Material packaging • Discussed formwork • Concrete debris • Used containers |
| Biomass | <ul style="list-style-type: none"> • Site clearing (oil palm and rubber) | <ul style="list-style-type: none"> • Empty fruit branches • Monocarp fruit fibers • Palm kernel shells • Oil palm trunks • Rubber trees |
| Demolition Waste | <ul style="list-style-type: none"> • Demolition of houses, shops and structures | <ul style="list-style-type: none"> • Concrete blocks • Steel reinforcement • Wood • Glass and plastic • Zinc and other metals • Piping • Ceramic tiles |
| Excavated / Spoil material | <ul style="list-style-type: none"> • Earthworks (cut and fill) • Tunnel construction | <ul style="list-style-type: none"> • Excavated material (tunnel) • Unsuitable material |
| Scheduled wastes | <ul style="list-style-type: none"> • Fuel storage area • Scheduled waste storage area • Maintenance of construction vehicles | <ul style="list-style-type: none"> • SW 305 – Spent lubricant oil • SW 306 – Spent hydraulic oil • SW 408 – Contaminated soil, debris or matter resulting from cleaning-up of a spill of chemical, mineral oil or scheduled wastes • SW 409 – Disposed containers, bags or equipment contaminated |

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| Category of Waste | Sources of Waste | Type of Wastes |
|-------------------|--|---|
| | | with chemicals, pesticides, mineral oil or scheduled wastes <ul style="list-style-type: none"> • SW 410 – Rags, plastics, papers or filters contaminated with scheduled wastes • SW 422 – A mixture of scheduled and non-scheduled waste |
| Solid Waste | <ul style="list-style-type: none"> • Operations at site office • Operations of CLQ | <ul style="list-style-type: none"> • Food waste • Paper • Cans • Bottles and plastics |

7.5.1.3 Biomass Clearing Operations

The HSR Project will require as part of site clearing operations the extensive felling of rubber trees and palm oil stands. In this respect approximately 84,873 tons of rubber trees and 54,433 tons of oil palm. The majority (75 % to 80 %) of the HSR alignment will traverse through tree crop plantations, i.e. rubber and oil palm estates / small holders. Clearance of the route to construct the alignment will result in the generation of significant amounts of rubber and oil palm vegetation which has to be adequately managed in order to prevent adverse environmental impacts. It has been assumed that the mass unit rate of oil palm and rubber is 47 tones/ha and 96.12 tonnes/ha respectively. This will require felling and subsequent disposal at areas external to the alignment (**Table 7-19**). Potentially large amounts of shrub and remnant ground based vegetation will also require disposal in an amicable manner without inducing adverse environmental impacts.

Table 7-19: Biomass Generation Amounts

| States | Estimated Area (ha) | Estimated Waste Generated (tonnes) |
|----------------------------|---------------------|------------------------------------|
| FT. Kuala Lumpur | - | - |
| Selangor and FT. Putrajaya | - | - |
| Negeri Sembilan | 411 | 22,411 |
| Melaka | 380 | 34,764 |
| Johor | 1,251 | 82,131 |
| TOTAL | | 139,306 |

In the past, resort to open burning of tree crops was the main solution adopted, especially if plantations were to be converted into urban type developments, or when replanting activities occurred. However this type of activity creates significant adverse air quality impacts which can have detrimental health consequences on surrounding communities, both locally and regionally. Open burning can lead to significant emissions of gaseous pollutants, not only particulate matter but also oxides of nitrogen, volatile organic compounds, carbon dioxide and carbon monoxide. Besides this, incomplete combustion often leaves a large amount of residual matter (ashes) for disposal which may be re-suspended by strong winds, thus further contributing to dust emissions. Overall open burning of the vegetation may lead significant worsening of the air quality at the project site. However in this case, as there will be **no open burning of vegetation** during site clearance activities thus abiding with regulations forbidding open burning to dispose of felled tree crops. Resort to other less environmental intimidating measures are being carried out currently.

Potential adverse environmental impacts can materialize as a result of improper disposal of large amounts of tree stumps, shrubs and ground vegetation. Indiscriminate disposal practices can lead to (a) significant degradation in air quality, albeit over a short term period; if practice of uncontrolled burning the biomass is adopted, (b) impede surface drainage systems and rivers leading to localized flooding episodes (potential long term impact) and degradation in water quality; (c) formation of pest breeding and feeding grounds and hence spread of diseases in neighboring human habitats potentially a long term impact); (d) reduce the economic value of the land mass, or eliminate opportunities to productively make use of the land area which are used to receive the waste loads (potential long term impact); and (e) creation of unaesthetic visual impacts thereby reducing the amenity value of surrounding areas.

There are alternative methods for proper management of the biomass which results from felling both oil palm and rubber trees. Such methods are reviewed and discussed in the following Mitigation Measures Chapter.

7.5.1.4 Soil Materials

The total amount of excess excavated soils that have to be disposed away from the HSR alignment amounts to about 1,111,403 m³ (**Table 7-20**). Construction of the HSR alignment within FT. Kuala Lumpur, Melaka and the Selangor per se will not require any fill materials

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to be imported to the work sites. The construction of HSR alignment within the Negeri Sembilan and Johor will on the other hand require a total import of 10,957,788 m³ of imported fill material. Tunneling works and construction of elevated structure foundations are significant contributors of excavated materials; whilst embankment construction to support At-Grade structure will require extensive amounts of imported fill material.

Table 7-20: Estimates of Earthworks Quantities

| States | Total Cut (m ³) | Total Fill (m ³) | Total Earthworks (m ³) | Reused Cut (m ³) | Fill to be Imported (m ³) | Excess Cut for Export (m ³) |
|-----------------------------------|-----------------------------|------------------------------|------------------------------------|------------------------------|---------------------------------------|---|
| FT. Kuala Lumpur | 811,109 | 253,678 | 1,064,787 | 283,888 | 0 | 527,221 |
| Selangor and FT. Putrajaya | 768,742 | 245,341 | 1,014,083 | 269,060 | 0 | 499,682 |
| Negeri Sembilan | 5,841,500 | 7,365,000 | 13,206,500 | 0 | 1,523,500 | 0 |
| Melaka | 4,089,500 | 4,005,000 | 8,094,500 | 0 | 0 | 84,500 |
| Johor | 16,684,792 | 26,119,080 | 42,803,872 | 0 | 9,434,288 | 0 |
| TOTAL | <u>28,195,643</u> | <u>37,988,098</u> | <u>66,183,742</u> | <u>552,948</u> | <u>10,957,788</u> | <u>1,111,403</u> |

Note: 35 % of the Total Cut material is utilized as Reused Cut for FT. Kuala Lumpur and Selangor while the excess cut material obtained in Melaka is disposed as Excess Cut for Export.

Excavation volumes related to construction of elevated structure pier foundations will yield a total of about 1,275,000 m³ of soil. Approximately fifty percent of the excavated soils, i.e. 637,500 m³ of soil, may have to be disposed off-site, with the remaining used as backfill material. Temporary stockpiling of about 120 m³ of soil will be required beside each pier. Particular attention towards preventing soil erosion is needed if Elevated Structure construction is carried out within urban areas. This is because the soil mounds around elevated structure piers are generally not adequately protected from rain, resulting in spillover of soil particles into adjacent road surfaces and into nearby road side drains by rain water. Although the piers will be spread over the length of roadways (at 30 m intervals), an accumulation of deposited soils in roadside drains can aggravate flooding problems. The deposited soils may adversely impact on the flow capacity of the drains leading to flash flooding. The carryover of soil particles to adjacent road pavements will also induce dust dispersions as a result of vehicles traversing over them during dry weather.

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At this juncture, in the absence of confirmatory soil data along the HSR alignment, it is not possible to come to a conclusion as to whether all, or part of, the cut volumes generated in FT. Kuala Lumpur and Selangor can be deployed for use in areas where fill material is required along other areas of the alignment. This is because the majority of cut soils generated in FT. Kuala Lumpur and Selangor is from tunnel excavation works in geological formations which yield materials (schist and Kenny Hill formation) that are not suitable for embankment construction. As such it is anticipated that only a fraction of the soil material excavated from tunnels can be reutilized as fill material at other sectors of the alignment.

Therefore, especially within the State of Johor, fill material has to be imported to the work sites along the HSR alignment from existing or newly developed borrow sites. The opening of new borrow sites, and their operations, will entail significant environmental impacts to occur in itself; inducing potentially adverse air and water impacts as well as noise and vibration impacts. The intensity of impacts will be dependent on the location of the borrow area(s) in relation to human habitats.

Furthermore the required fill material has to be transported to the work sites along the alignment. The normal method is to employ 15 m³ dump trucks to transport the fill material. Considering the large amounts of fill required it is estimated that a total of 100,000 dump trucks will be required to operate over a time period of 30 to 36 months assuming that earthworks for all sectors of the alignment are carried out simultaneously. Assuming an average round trip distance of 40 km from borrow area to work site and back the total truck mileage incurred would be of the order of 4 million truck/ km. The associated carbon dioxide emissions from this rate of travel are estimated at approximately 30 tons over a 30 to 36 months period; which translates to 30 to 45 kg/day.

Transportation routes have to be selectively chosen in order to avoid imposing adverse dust, noise and vibration impacts on surrounding habitual areas; and avoid disrupting traffic circulation patterns along public roads, and inducing higher incidences of vehicular accidents. Transportation routes across rural zones should be located at least 100 m away from residential abodes.

7.5.1.5 Construction and Demolition Wastes

The amounts of construction and demolition wastes that could be generated by Project activities are summarized in **Table 7-21**.

Table 7-21: Estimates of Construction and Demolition Wastes

| State | Construction Waste | | Demolition Waste | |
|-----------------------------------|------------------------|------------------------------------|---------------------------------|------------------------------------|
| | Area (m ²) | Estimated Waste Generated (tonnes) | Built-Up Area (m ²) | Estimated Waste Generated (tonnes) |
| FT. Kuala Lumpur | 26 | 3 | 68,650 | 71,945 |
| Selangor and FT. Putrajaya | 83 | 9 | 252,100 | 264,200 |
| Negeri Sembilan | 13 | 1 | 96,950 | 101,603 |
| Melaka | 13 | 1 | 84,600 | 88,660 |
| Johor | 172 | 20 | 184,800 | 193,670 |
| TOTAL | 307 | 34 | 687,100 | 720,078 |

Preliminary estimates indicate that there could be large amounts of demolition wastes that can be generated through the removal of structures within the HSR alignment. More detailed surveys are required to inventorize the nature and type of buildings and other structures that require removal. On the other hand construction wastes arising from the construction of stations, maintenance depots and elevated structure are comparatively low.

These types of wastes if disposed indiscriminately can induce significant impacts. Recycling and reuse of residual material can lower significantly the amount of such wastes requiring ultimate disposal. It is therefore proposed that Contractors formulate a plan of action to reduce the amount of wastes that are required to be disposed to the environment.

7.5.1.6 Scheduled Wastes

The amount of scheduled wastes that can be generated through Project activities is deemed manageable. It is essential that the Contractor closely follow the Environmental Quality (Scheduled Works) Regulation 2005 Act and its schedules regarding storage, collection,

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transportation and treatment / recycling of toxic and hazardous wastes in order to avoid inducing adverse environmental impacts.

7.5.1.7 Operational Phase

Once the operational phase of the HSR Project commences, the type of wastes generated will comprise of mainly domestic waste from the Stations, and both domestic type and scheduled wastes from the Depots and the Maintenance Bases. The table below describes the types of waste generated during this stage.

Table 7-22: Types of Waste during Operational Phase

| Category of Waste | Sources of Waste | Type of Wastes |
|-------------------|--|--|
| Domestic Waste | <ul style="list-style-type: none"> Station facilities <ul style="list-style-type: none"> Commercial facilities, offices, depots and yards Passengers | <ul style="list-style-type: none"> Food wastes Bottles Glass Plastics Aluminium cans Metals |
| Scheduled Waste | <ul style="list-style-type: none"> Depots, and maintenance bases | <ul style="list-style-type: none"> Disposed containers, bags, or equipment contaminated with chemicals, pesticides, mineral oil or scheduled wastes Contaminated soil, debris or matter resulting from cleaning up of a spill, chemical oil or scheduled wastes Rags, plastics, papers or filters contaminated with scheduled wastes Wastes of inks, paints, pigments, lacquer, dye or varnish Spent hydraulic oil Spent lubricating oil Oily residue from automotive workshop Oil water mixture such as ballast water Wastes from electrical and electronic assemblies |

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A significant amount of municipal type solid wastes will be generated from all Stations and Depots. These will have to be handled in the proper manner to avoid adverse environmental impacts (littering, odour problems, and inducing sites for disease vector proliferation). The estimated amounts of municipal solid wastes that will be generated at the stations and depots are presented in **Tables 7-23**

Table 7-23: Domestic Wastes Generated at Stations and Depots

| Station / Depot | Estimated Waste Generated in 2030 (tonnes/year) | Estimated Waste Generated in 2060 (tonnes/year) |
|--------------------------------------|---|---|
| Bandar Malaysia | 1,516 | 2,017 |
| Sepang- Putrajaya | 618 | 658 |
| Seremban | 717 | 909 |
| Melaka | 693 | 841 |
| Muar | 632 | 690 |
| Batu Pahat | 651 | 737 |
| Iskandar Puteri | 1,262 | 1,376 |
| Total | 6,089 | 7,218 |
| Light Depot + LMB | 3,208 | 3,208 |
| Heavy Maintenance Base (Muar) | 470 | 470 |
| Main Depot + LMB | 5,033 | 5,033 |
| Total | 8,711 | 8,711 |
| GRAND TOTAL | 14,800 | 15,929 |

1) The Gross Floor Area for the Bandar Malaysia and Iskandar Puteri Stations are 26,000m²

2) The Gross Floor Area for the remaining stations are 13,000m²

3) The Gross Floor Area for the Light Depot + LMB, Heavy Maintenance Base and Main Depot + LMB are 70,000, 10,000 and 110,000 m² respectively.

4) The annual ridership for 2030 for the stations Bandar Malaysia, Bangi - Putrajaya, Seremban, Melaka, Muar, Batu Pahat and Iskandar Puteri are 5,134,000, 371,000, 1,907,000, 1,540,000, 592,000, 888,000, and 1,165,000 respectively.

5) The annual ridership for 2060 for the stations Bandar Malaysia, Bangi - Putrajaya, Seremban, Melaka, Muar, Batu Pahat and Iskandar Puteri are 12,959,000, 842,000, 4,927,000, 3,850,000, 1,494,000, 2,225,000, and 2,939,000 respectively.

6) The no. of staff allocated for all the stations and depots are 60 and 600 respectively.

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These wastes would need to be appropriately disposed or otherwise environmental hazards could materialize and potentially endangering public health status within the surrounding area. These impacts comprise of the following:

- Improper management of domestic wastes resulting in the formation of garbage piles will induce odour and nuisance impacts, and create suitable habitats for pests and vermin. These issues can cause spread of diseases among the public.
- The leachate from the garbage piles can seep into waterways and soil to cause water and soil pollution.
- Blockage of drainage and waterways from the illegal dumping of garbage wastes.
- Water and soil contamination due to the spillage and improper management of scheduled wastes.

There are well established services available to collect domestic type solid wastes as well as toxic and hazardous wastes and to transport the wastes to a facility for proper treatment and disposal. It is therefore concluded that no significant impacts will materialize from the generation of solid wastes at the Depots and Stations. However, vigilance and control over fly litter wastes needs to be exercised at the Stations and Depots, and at peripheral areas, in order to prevent occurrences of adverse environmental impacts that could lead to flooding episodes arising from clogging of peripheral drainage systems.

7.6 SURFACE WATER QUALITY

7.6.1 Water Quality

7.6.1.1 Construction Phase

The main activities during construction that will impact water quality were listed below:

| Project Activities |
|---|
| Land Clearing |
| Demolition |
| Construction Of Access Roads |
| Earthwork |
| Drainage |
| Transportation Of Materials / Equipment |
| Vehicle Movement |
| Disposal Of Unsuitable Material |
| Waste / Wastewater Generation |
| Disposal Of Solid And Construction Waste / Biomass |
| Establishment Of Site Office, Storage Areas |
| Establishment Of Workers Camp |
| Piling |
| Construction Of Station / Depots / Maintenance Base |
| Construction Of Elevated Structures |
| Construction Of At-Grade Structures |
| Abandonment |

Every state traverses by the HSR alignment will have their specific activities that may impact the water quality of nearby water bodies namely rivers.

Land clearing and earthworks operations promote devegetation and dislodgement of soil particles which may then be transported to surrounding drainage systems by surface water flows. Drainage impedances (blockages) could occur resulting in localized flooding episodes that could impact adversely on surrounding habitats.

A) FT. Kuala Lumpur

The main activities in the FT. Kuala Lumpur that will affect water quality will be the earthworks for the construction of Bandar Malaysia development and at Bandar Malaysia Station. Other activities such as land clearing, demolition and construction of access roads were minimal and were expected to create little impacts on water quality. Erosion from the open space or earthworks will bring sediment through drainage and eventually into Sg. Klang especially during wet season. This will inflate the levels of TSS in the river water.

The HSR alignment that will traverse Sg. Kerayong will be an Elevated Structure. During piling (for the construction of pillars) for the Elevated Structures, it will disturb the relevant soil and if not adequately protected will introduce sediments into Sg. Kerayong thus inflating the turbidity and TSS levels of the river water. This is especially so if the piling is close to the river bank.

B) Selangor

Activities expected to create impacts on water quality were as follows:

1. Construction of Sepang-Putrajaya Station.
2. Land Clearing
3. Earthworks
4. Construction of Serdang Depot
5. Construction of tunnels

Construction of the Sepang-Putrajaya Station will not involve major land clearing and earthworks. The potential impact to water quality would be if the activities were carried out during monsoon season. Erosion from the land clearing and earthworks will bring sediment through drainage and eventually into Sg. Langat, thus inflating the levels of TSS in the river water.

The HSR alignment will traverse crossing Sg. Semenyih and Sg. Batang Labu, where it is an upstream of intake points for Sg. Semenyih WTP and Sg. Labu WTP, respectively. Although the alignment will be elevated, the piling activities for the crossing the rivers will disturb soil at the area if it is not properly protected. The water quality of streams and rivers could be

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degraded by uncontrolled wash out of soil particles and vegetative matter, and as a consequence diminish their resource capability to support downstream socio-economic activities

There is tunnel from Kg Baru Salak Selatan to Taman Sri Serdang and within Kg. Jenderam Hilir. During the tunnel construction, there will be impacts on water quality of the rivers namely from the slurry produced and from the leaching of rock and soil which may contain solids as well as dissolved metals.

The construction of Light Depot and LMB at Serdang will affect water quality of Sg. Ramal which will eventually affecting Sg. Langat. However with proper measures such as avoiding construction during monsoon/ wet season, constructing sediment pond or trap, these impacts are expected to be minimal.

C) Negeri Sembilan

Similar activities listed above are also expected to affect water quality in Negeri Sembilan.

Site clearing for the constructions of Seremban Station and the HSR alignment will expose the soil for erosion especially during monsoon/ wet season if not compacted immediately. This will also lead to increase runoff and sediment flow into nearby rivers namely Sg. Jijan, Sg. Anak Ayer Sebong, Sg. Gadong, Sg. Lukut Besar, Sg. Jimah, Sg. Putting, Sg. Siliau, Sg. Salak Leigh, Sg. Ayer Hitam and Sg. Linggi particularly those downstream of the alignment and if adequate drainage system was not built.

Since all intake points for WTPs were located upstream of the alignment, there will be no issue of water quality to the treatment plants. Although the HSR alignment traverses Sg. Linggi, the alignment crossing is located downstream which means that it will not affect the Sg. Linggi WTP where the intake point is located at Kuala Sawah.

D) Melaka

In Melaka, construction activities which may affect water quality includes those related to the construction of the HSR alignment and Melaka Station i.e. land clearing and associated

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earthworks. Biomass produced from the site clearing will contaminate the water quality through the decomposing, if they were not disposed properly at disposal site.

The construction of Melaka Station, which will be elevated, will not pose significant impact to water quality since it is not located near to the river. However, earthworks and land clearing activities for the station will promote surface erosion thus generating runoff containing high solids especially during wet season. Through series of drains and small streams, the solids will eventually flow into Sg. Melaka.

Land clearing and earthworks for the construction of the HSR alignment particularly within the catchment of Sg. Melaka will have a serious impact due to the presence of a water intake point for the Durian Tunggal WTP. Any deterioration of quality of this segment of Sg. Melaka due to earthworks and land clearing will jeopardize the operation of Durian Tunggal WTP and thus water supply to the community.

E) Johor

Similar activities associated with the construction of the HSR alignment, construction of Stations (at Muar, Batu Pahat and Iskandar Puteri), construction of HMB and Main Depot (at Muar and Pontian), the related earthworks and land clearings were expected to create impacts on water quality of relevant water bodies (rivers and drains).

All earthworks, land clearings and piling activities for the HSR alignment, if carried out during monsoon/ wet season and without adequate protective measures, will cause erosion and surface runoff containing high suspended solids that will contaminate water bodies with TSS. The affected water bodies would mainly be Sg. Kesang, Sg. Belemang Besar, Sg. Muar, Sg. Pagoh, Parit Ayer Putih, Sg. Simpang Kiri, Sg. Simpang Kanan, Sg. Senggarang, Parit Lapis Seri Dalam, Parit Lapis Sempadan, Sg. Benut, Sg. Sanglang, Sg. Pontian Besar, Sg. Ulu Choh, Sg. Pulai and Sg. Gelang Patah.

There are two (2) tunnels located in the HSR alignment in Johor namely Bukit Naning 1 and Bukit Naning 2. During the tunnel constructions, there will be impacts on water quality to the nearby water bodies (Sg. Pagoh and Parit Ayer Putih) from the slurry produced and from the leaching of rock and soil which may contain solids as well as dissolved metals. Protective measure is important at this area in order to avoid any pollution to occur.

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Earthworks and land clearings for the construction of Muar Station will create solid pollutions that will flow into Sg. Pagoh and eventually into Sg. Muar. For Batu Pahat Station, the solids will flow into Sg. Simpang Kanan and for the construction of Iskandar Puteri Station, the solid pollution will contaminate Sg. Pulai and eventually the estuary area.

Related earthworks and land clearing for the construction of HMB at Muar and Main Depot and LMB at Pontian which will involve large area of land (especially at Pontian), will definitely cause solid pollution from surface runoff which will pollute nearby water bodies namely Sg. Muar and Sg. Ulu Choh, respectively. This impact will be enhanced when the construction activities were carried out during wet season and no effective protective measures were taken.

Water Quality Modeling

For this study, the simulation for Total Suspended Solids (TSS) was undertaken where ever the HSR alignment crossing at upstream of any water intakes to predict level of TSS before reach water intake point during construction phase. The followings are the objectives for this study:-

- i. To simulate the concentration of TSS during the construction phase along the river stretch and before reaching water intake point. The level of TSS from simulation shall be compared with the National Water Quality Standard (NWQS).

The study has taken into considerations the following conditions:

1. Existing Conditions (due to the external inputs such as tributaries)
2. Inputs at loading points

Potential Point Source and Selected Scenarios

i. Potential Point Source

Potential point source is a point where pollutant load namely TSS, BOD and COD confluence or discharge point to the river. The point sources referred in this study represent discharge from river-crossing, depot or station either during construction phase or during operation phase. Detailed point source information is shown in the following table.

Potential Point Sources recognized from selected rivers

| Water Intake | Point Source |
|---------------------------|---|
| Water Intake Semenyih | TSS from river crossing at Sg Semenyih. |
| Water Intake Kesang | TSS s from river crossing at at Sg Kesang. |
| Water Intake Batang Labu | TSS from river crossing at Sg Batang Labu. |
| Water Intake Bukit Tampoi | TSS from river crossing at Sg Langat. |
| Water Intake Melaka | TSS from river crossing at Sg Melaka and Sg DurianTunggal |

ii. Performed Scenarios

There are three (3) scenarios that were simulated which are:

➤ **Scenario 1: Baseline Conditions**

- Assumption of natural pollutant content in river system prior to construction.
- The values gathered were compared to national guideline in order to estimate existing river quality based on NWQS.

➤ **Scenario 2: Pollutants Trend With Mitigation Measures**

- Assuming construction activities following LD-P2M2 working recommendation.
- The TSS discharge from construction sites should be in accordance with baseline condition or NWQS

➤ **Scenario 3: Worst Case Scenario**

- Assuming no LD-P2M2 in place.
- Soil loss data on Pre-bulk Grading Stage (without Mitigation Measures) been used to estimate total TSS concentration in river system (mg/L). The estimation of soil loss data is shown in **Section 7.6.2.1.3.**

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Table 7-24: Summary of TSS Concentration at the Respective Water Intakes

| Water Intake | Existing* (mg/L) | Worst Case (mg/L) | With Mitigation Measures (mg/L) |
|-----------------------------|--------------------------|----------------------|------------------------------------|
| Water Intake Semenyih | 80 (<i>Class III</i>) | 215 | 82 (<i>Class III</i>) |
| Water Intake Batang Labu | 60 (<i>Class III</i>) | 18,956 | 64 (<i>Class III</i>) |
| Water Intake Sg Kesang | 63 (<i>Class III</i>) | 7212 | 65 (<i>Class III</i>) |
| Durian Tunggal water intake | 108 (<i>Class III</i>) | 1224 | 116 (<i>Class III</i>) |
| Water Intake Bukit Tampoi | 42 (<i>Class II</i>) | 9963 | 47 (<i>Class II</i>) |

* The existing value of TSS was re-sampled for the Water Quality Modelling Study

Table 7-23 shows the summary of the simulation at all affected water intakes. In conclusion, if LD-P2M2 is in place, the concentration of TSS at the water intake remains unchanged, based on the NWQS.

7.6.1.2 Operational Phase

The Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were simulated to predict impact of Sewage Treatment Plant (STP) from the proposed station and depot to predict level of both parameter in river system during operational stage.

The objective of this study:-

- To simulate the concentration of BOD and COD as a result of discharged from the Serdang Depot and Melaka Station during operational stage. Discharge of BOD and COD from the STP should adhere to Standard A of EQA, 1974; Environmental Quality (Sewage) Regulation 2009.

Potential Point Source and Selected Scenarios

i. Potential Point Source

Potential point source is a point where pollutant load namely BOD and COD confluence or discharge point to the river. The point sources referred in this study represent discharge from river-crossing, depot or station during operation phase. Detailed point source information is shown in the following table.

Potential Point Sources recognized From Sg. Langat and Sg. Melaka

| Water Intake | Point Source |
|---------------------------|--|
| Water Intake Bukit Tampoi | BOD and COD from Serdang Depot which will flow to Sg Ramal and then finally to Sg Langat. |
| Water Intake Melaka | BOD and COD from Melaka Station which will flow to Sg Durian Tunggal and finally to Sg Melaka. |

ii. Performed Scenarios for BOD and COD Simulation

There are three (3) scenarios that were simulated which are:

Scenario 1: Baseline Conditions

- Assumption of natural BOD and COS pollutants content in river system prior to construction.
- The values gathered were compared to Standard A of EQA, 1974; Environmental Quality (Sewage) Regulation 2009.

Scenario 2: Treated Effluent

- BOD and COD to be discharged from STP in accordance to Standard A of EQA, 1974; Environmental Quality (Sewage) Regulation 2009.

Scenario 3: Worst Case Scenario (Untreated Effluent)

- The maximum concentration of BOD and COD flow into the river system based on Malaysian Industry Sewerage Guidelines, Untreated Domestic Sewage Design Values, Volume 4.

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Table 7-25 summarizes the results for the modeling of BOD and COD at the respective water intakes.

Table 7-25: Summary of BOD and COD Concentration at the Respective Water Intakes

| Parameter | Water Intake | Existing* (mg/L) | Worst Case (Untreated Effluent) (mg/L) | Treated Effluent (mg/L) |
|-----------|--------------|-------------------------|---|-------------------------------|
| BOD | Sg Melaka | 1.9 (<i>Class II</i>) | 13.8 | 2.7 (<i>Class II</i>) |
| | Sg Langat | 1.8 (<i>Class II</i>) | 6 | 2.17 (<i>Class II</i>) |
| COD | Sg Melaka | 15 (<i>Class I</i>) | 38 | 19 (<i>Class II</i>) |
| | Sg Langat | 15 (<i>Class II</i>) | 28 | 17 (<i>Class II</i>) |

* The existing value of BOD and COD were re-sampled for the Water Quality Modelling Study

During operation of the HSR Project, the impact of water quality to the water bodies along the alignment from Bandar Malaysia to Iskandar Puteri is expected to minimal. However the following aspects of the operation will be of significant to water quality:

1. Maintenance of drain pipes at all pillars for the elevated structures. Inadequate or improper maintenance of drain pipes will promote the growth of fungus or mosses that may clogged the pipes thus render them ineffective to drain the water.
2. Operation of depots especially the HMB at Muar will produce solid and liquid wastes. These will include garbage and other solid wastes, sewage and oil & grease. Some of them were categorised as scheduled waste and should be handled properly.
3. Leaking fuel from Skid Tanks, together with discharge of lubricants, paint residues and solvents could be discharged to water courses resulting in the degradation of water qualities that could upset Wastewater Treatment Plant operations and have negative impacts on aquatic fauna and flora, and on subsistence fisheries and cage culture / aquaculture projects.

7.6.2 Soil Erosion and Sedimentation

7.6.2.1 Construction Phase

Development of Stations, Maintenance Depots and the HSR alignment shall require land clearing and earthworks in order to establish adequate platform levels for construction of structures. Land Disturbance activities will induce soil dislodgement and translocation to the receiving water bodies, where the eroded soil particles will either increase the turbidity level of the receiving waters or settle out at the bottom of the watercourse. Deposition of solids in waterways can reduce their carrying capacities over time and possibly lead to bank overflows and resulting flooding of neighboring areas. Increase in turbidity levels can disrupt the operations of economic activities dependant on the waterway (for example the operation of water treatment plants) and induce negative impact on the aquatic ecology of the waterways as well as induce adverse impact on aquaculture practices.

An exercise has been carried out in this EIA study to assess the soil erosion and sedimentation risks which project facilities under construction can impact on the environment. Universally recognized soil erosion and sedimentation models have been employed to assess the extent of these rates.

7.6.2.1.1 Scope of Assessment

General Constraints

Soil erosion and sedimentation risk of the HSR alignment, Stations and Depot are largely influenced by the land use, soil type, rainfall, physical terrain and structure type of the alignment.

The constraints faced for the assessment in soil erosion and sedimentation are listed as follows:

- (a) The Project site and alignment is based on preliminary design concept. Structure type of the alignment has been identified. However, the exact location of Elevated Structure piers is not available during the time of study.

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- (b) The layout of station is available but the earthwork details such as platform levels, cut and fill volume, disposal and borrow sites, etc. are not available. Specific engineering application of slope stability, retaining wall, etc. is not available at this stage.
- (c) The chainage numbers of the alignment used in the study are subject to change during the detailed design stage.
- (d) The actual construction method will only be available during the detailed design stage.
- (e) The cut and fill slope profiles of the at-grade segments are based on preliminary design and are subject to further refinement during detailed design stage.
- (f) The HSR alignments for construction work provided in the plans are indicative only. The actual width and shape of HSR alignment may vary during the detailed design stage.
- (g) Very limited number of soil test has been carried out. The detailed soil investigation will only be conducted during the detailed design stage.
- (h) Surveyor's contours are not available at this stage. LiDAR contours are used in the assessment of the slope steepness and slope length. Spot levels at flat areas are not available to determine accurately the lowest points and terrain characteristic. Some segments do not have LiDAR contours due to changes of the alignment during the course of study.
- (i) Details and layout of the tunnel portals are not available during the time of study
- (j) For alignment with At-Grade Structure, the detailed cut and fill slope profiles are not available during the time of study.

In view of the constraint above, the focus of erosion and sedimentation assessment for this project is at the Stations, Depots, HMB and crossing of the alignment segments over major river systems, which are considered to be the most environmentally sensitive in terms of [soil](#) erosion and sedimentation.

A) FT. Kuala Lumpur, Selangor & FT. Putrajaya

Soil erosion and sedimentation risk of the HSR alignment, Stations and Depot are largely influenced by the land use, soil type, physical terrain and structure type of the alignment.

The alignment traverses through approximately 37.7 km across FT. Kuala Lumpur-FT. Putrajaya-Selangor states from Bandar Malaysia Station (north) to Kg. Salak Tinggi (south). A total of 56% of the alignment is on Elevated, 31% in Tunnel and 13% is At-Grade structure. There is one (1) station at FT. Kuala Lumpur (Bandar Malaysia Station), and one

(1) at FT. Putrajaya-Selangor area (Sepang-Putrajaya Station). The Light Depot and LMB is located at Serdang, Selangor.

The following areas are quantitatively assessed:

- (a) Bandar Malaysia Station
- (b) Sepang-Putrajaya Station
- (c) Light Depot and LMB at Serdang
- (d) Alignment crossing at Sg. Kerayong
- (e) Alignment crossing at Sg. Langat
- (f) Alignment crossing at Sg. Semenyih

B) Negeri Sembilan

Soil erosion and sedimentation risk of the HSR alignment and station are largely influenced by the land use, soil type, physical terrain and structure type of the alignment.

The alignment traverses through approximately 51.8 km across Negeri Sembilan from Kg. Salak Tinggi (north) to Sg. Linggi (south). A total of 27% of the alignment is on Elevated, 2% in Tunnel and 71% is At-Grade Structure. There is one (1) station (Seremban Station) located in the state of Negeri Sembilan.

The following areas are quantitatively assessed:

- (a) Seremban Station
- (b) Alignment crossing at Sg. Batang Labu (which shares the catchment with Selangor state)
- (c) Alignment crossing at Sg. Lukut Besar
- (d) Alignment crossing at Sg. Linggi (which shares the catchment with Melaka state)

C) Melaka

Soil erosion and sedimentation risk of the HSR alignment and Station are largely influenced by the land use, soil type, physical terrain and structure type of the alignment.

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The alignment traverses through approximately 56.5 km across Melaka state from Sg. Linggi (north) to Sg. Kesang (south). A total of 34% of the alignment is on elevated and 66% is at-grade structure. There is one (1) station (Melaka Station) allocated for the state of Melaka.

The following areas are quantitatively assessed:

- (a) Melaka Station
- (b) Alignment crossing at Sg. Linggi (which shares the catchment with Negeri Sembilan state)
- (c) Alignment crossing at Sg. Durian Tunggal and Sg. Melaka
- (d) Alignment crossing at Sg. Ayer Panas
- (e) Alignment crossing at Sg. Bemban
- (f) Alignment crossing at Sg. Kesang (which shares the catchment with Johor state)

D) Johor

Soil erosion and sedimentation risk of the HSR alignment and station are largely influenced by the land use, soil type, physical terrain and structure type of the alignment.

The alignment traverses through approximately 181.7 km across Johor state from Sg. Kesang (north) to the Straits of Johor (south). A total of 55% of the alignment is Elevated, 1% in Tunnel and 44% is At-Grade structure. There are three (3) stations (Muar, Batu Pahat and Iskandar Puteri Stations) allocated for the state of Johor. Main Depot and LMB is located at Pekan Nenas, Pontian while HMB is located near Muar Station.

The following areas are quantitatively assessed:

- (a) Muar Station
- (b) Batu Pahat Station
- (c) Iskandar Puteri Station
- (d) Main Depot & LMB
- (e) HMB
- (f) Alignment crossing at Sg. Kesang (which shares the catchment with Melaka)
- (g) Alignment crossing at Sg. Muar
- (h) Alignment crossing at Sg. Simpang Kiri

- (i) Alignment crossing at Sg. Simpang Kanan
- (j) Alignment crossing at Sg. Pontian Besar
- (k) Alignment crossing at Sg. Ayer Hitam Besar
- (l) Alignment crossing at Sg. Ulu Choh
- (m) Alignment crossing at Sg. Pulau
- (n) Alignment crossing at Sg. Jelutong
- (o) Alignment crossing at Sg. Gelang Patah

7.6.2.1.2 Soil Erosion Rate

Methodology

Topography of the study area is based on LiDAR survey due to the massive area involved. At the time of this study, detailed ground survey plans are not available.

The soil erosion and sediment risk assessment is carried based on manual assessment of the plan and profile with the LiDAR contour plan of 1 m interval. The Project site is divided into smaller parcels based on chainage distance and HSR alignment of 50 m width. In addition, any erosion and sedimentation control measures recommended shall be proposed to cover a considerable area size with similar erosion risk factors in consideration of practical implementation on the ground.

Assessment of soil erosion impact is carried out by using the Universal Soil Loss Equation (USLE). The USLE equation is shown below:

$$A = R * K * LS * C * P$$

| | | | |
|-------|----|---|--|
| where | A | = | mean annual soil loss (tonnes/ha/yr) |
| | R | = | rainfall erosivity factor (MJmm/ha/hr) |
| | K | = | soil erodibility factor [tonnes/ha/(MJmm/ha/hr)] |
| | LS | = | combined index of slope length and slope steepness |
| | C | = | crop cover factor |
| | P | = | soil management practice factor |

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Soil erosion assessments were carried out for various stages of development, i.e.:

- (a) Pre-development (existing environment);
- (b) During Pre-bulk Grading / Land Clearing (without erosion & sediment control measures);
- (c) During Pre-bulk Grading / Land Clearing (with erosion & sediment control measures);
- (d) During Post Bulk Grading / Construction (with erosion & sediment control measures);
- (e) Post-development / Operational.

The input parameters for USLE and the sources of information are summarised in **Table 7-26**:

Table 7-26: Input Parameters of USLE Calculation

| Label | Parameter | Reference Source |
|-----------|--|---|
| R Factor | Rainfall Erosivity Factor | Based on Rainfall Erosivity Map for Peninsular Malaysia in <i>Guidelines for Erosion and Sediment Control in Malaysia</i> (DID, 2010). |
| K Factor | Soil Erodibility Factor | Based on Soil Reconnaissance Map (Agriculture Dept, 2002) and <i>Guidelines for Erosion and Sediment Control in Malaysia</i> (DID, 2010) for the K Factor with the corresponding Soil Series. Where K Factor is absent in certain soil series, K Factor of another soil series which has the nearest characteristic and soil composition is used. Limited soil test results for the project site are referred. Borehole data is used to determine K Factor. K Factor is calculated based on Tew Equation as stated in <i>Guidelines for Erosion and Sediment Control in Malaysia</i> (DID, 2010). |
| LS Factor | Combined index of Slope Length and Slope Steepness | Based on LIDAR contour plans and <i>Guidelines for Erosion and Sediment Control in Malaysia</i> (DID, 2010). |
| C Factor | Crop Management Factor | Based on site visit, land use map, Google map and <i>Guidelines for Erosion and Sediment Control in Malaysia</i> (DID, 2010). |
| P Factor | Soil Conservation | Based on site visit, land use map, Google map and |

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| Label | Parameter | Reference Source |
|-------|-----------------|---|
| | Practice Factor | <i>Guidelines for Erosion and Sediment Control in Malaysia</i> (DID, 2010). |

Input data and result of the soil erosion assessment is shown in **Appendix 7H1**.

Soil Erosion Risk

Categorisation of the Erosion Rate (tonne/ha/year) is based on the Ministry of Agriculture (Pelan Hakisan Tanah Semenanjung Malaysia, 2002)

| Soil Erosion Class | Potential Soil Loss (Tonne/ha/year) |
|--------------------|-------------------------------------|
| Low | < 10 |
| Moderate | 10 – 50 |
| Moderately High | >50 – 100 |
| High | >100 – 150 |
| Very High | > 150 |

| Area | Existing Erosion Rate (tonne/ha/year) | Soil Erosion Class |
|---|---------------------------------------|-----------------------|
| FT. KUALA LUMPUR, SELANGOR AND FT. PUTRAJAYA | | |
| Bandar Malaysia Station | 0.5 – 33 | Low to Moderate |
| Sepang– Putrajaya Station | 4 – 381 | Low to Very High |
| Light Depot and LMB, Serdang | 18 – 623 | Moderate to Very High |
| Alignment crossing at Sg. Kerayong | 0.4 | Low |
| Alignment crossing at Sg. Langat | 19 | Moderate |
| Alignment crossing at Sg. Semenyih | 10 – 26 | Moderate |
| NEGERI SEMBILAN | | |
| Seremban Station | 21 – 174 | Moderate to Very High |
| Alignment crossing at Sg. Batang Labu | 49 – 189 | Moderate to Very High |
| Alignment crossing at Sg. Lukut Besar | 36 | Moderate |
| Alignment crossing at Sg. Linggi | 16 – 164 | Moderate to Very High |
| MELAKA | | |

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| Area | Existing Erosion Rate (tonne/ha/year) | Soil Erosion Class |
|---|--|-----------------------|
| Melaka Station | 14 – 759 | Moderate to Very High |
| Alignment crossing at Sg. Linggi | 17 – 164 | Moderate to Very High |
| Alignment crossing at Sg. Durian Tunggal and Sg. Melaka | 17 | Moderate |
| Alignment crossing at Sg. Ayer Panas | 59 | Moderately High |
| Alignment crossing at Sg. Bemban | 39 | Moderate |
| Alignment crossing at Sg. Kesang | 13 – 130 | Moderate to High |
| JOHOR | | |
| Muar Station | 6.5 | Low |
| Batu Pahat Station | 19 | Moderate |
| Iskandar Puteri Station | 13 – 145 | Moderate to High |
| Main Depot and LMB | 16 – 29 | Moderate |
| HMB | 5 – 7 | Low |
| Alignment crossing at Sg. Kesang | 13 – 130 | Moderate to High |
| Alignment crossing at Sg. Muar | 6 – 147 | Low to High |
| Alignment crossing at Sg. Simpang Kiri | 15 | Moderate |
| Alignment crossing at Sg. Simpang Kanan | 6 | Low |
| Alignment crossing at Sg. Pontian Besar | 69 – 85 | Moderately High |
| Alignment crossing at Sg. Ayer Hitam Besar | 14 – 115 | Moderate to High |
| Alignment crossing at Sg. Ulu Choh | 3 – 12 | Low to Moderate |
| Alignment crossing at Sg. Pulai | 8 | Low |
| Alignment crossing at Sg. Jelutong | 16 | Moderate |
| Alignment crossing at Sg. Gelang Patah | 5.7 | Low |

7.6.2.1.3 Result of Soil Erosion Assessment

A) FT. Kuala Lumpur, Selangor and FT. Putrajaya

Bandar Malaysia Station

Bandar Malaysia Station is located at the coordinates 03.1086278° E, 101.6939111° N. Bandar Malaysia Station is located at FT. Kuala Lumpur, within the catchment area of Sg. Kerayong. Sg. Kerayong is a tributary of Sg. Klang. **Figure 7-47** shows the location of the study area.



Figure 7-47: Location of Bandar Malaysia Station

Sepang-Putrajaya Station

Sepang-Putrajaya Station is located at the coordinates of 02.9460389° N, 101.7329278° E. Sepang-Putrajaya Station is located within the catchment area of Sg. Ayer Hitam. Ayer

Hitam. Sg. Ayer Hitam is a tributary of Sg. Ramal, which flows into Sg. Langat. **Figure 7-48** shows the location of the study area.



Figure 7-48: Location of Light Depot & LMB and Sepang-Putrajaya Station.

Light Depot and LMB

Light Depot and LMB is located at the coordinates of 02.9901167°N, 101.7340750° E. It is located at Serdang, within two (2) river catchments. The northern section of the Project site drains into Sg. Limau Manis on the west, a tributary of Sg. Langat. The majority area of the project site drains into the UPM lake on the east, which then flows into Sg. Ramal. Sg. Ramal is also a tributary of Sg. Langat. **Figure 7-48** shows the location of the study area.

Alignment Crossing at Sg. Kerayong

The crossing of the alignment on Sg. Kerayong is located at the coordinates of 03.1018722° N, 101.7021778° E, near Bandar Malaysia Station. **Figure 7-47** shows the location of the study area.

Alignment Crossing at Sg. Langat

The crossing of the alignment on Sg. Langat is located at the coordinates of 02.8968556° N, 101.7352917° E, at Dengkil, Selangor. **Figure 7-49** shows the location of the study area.

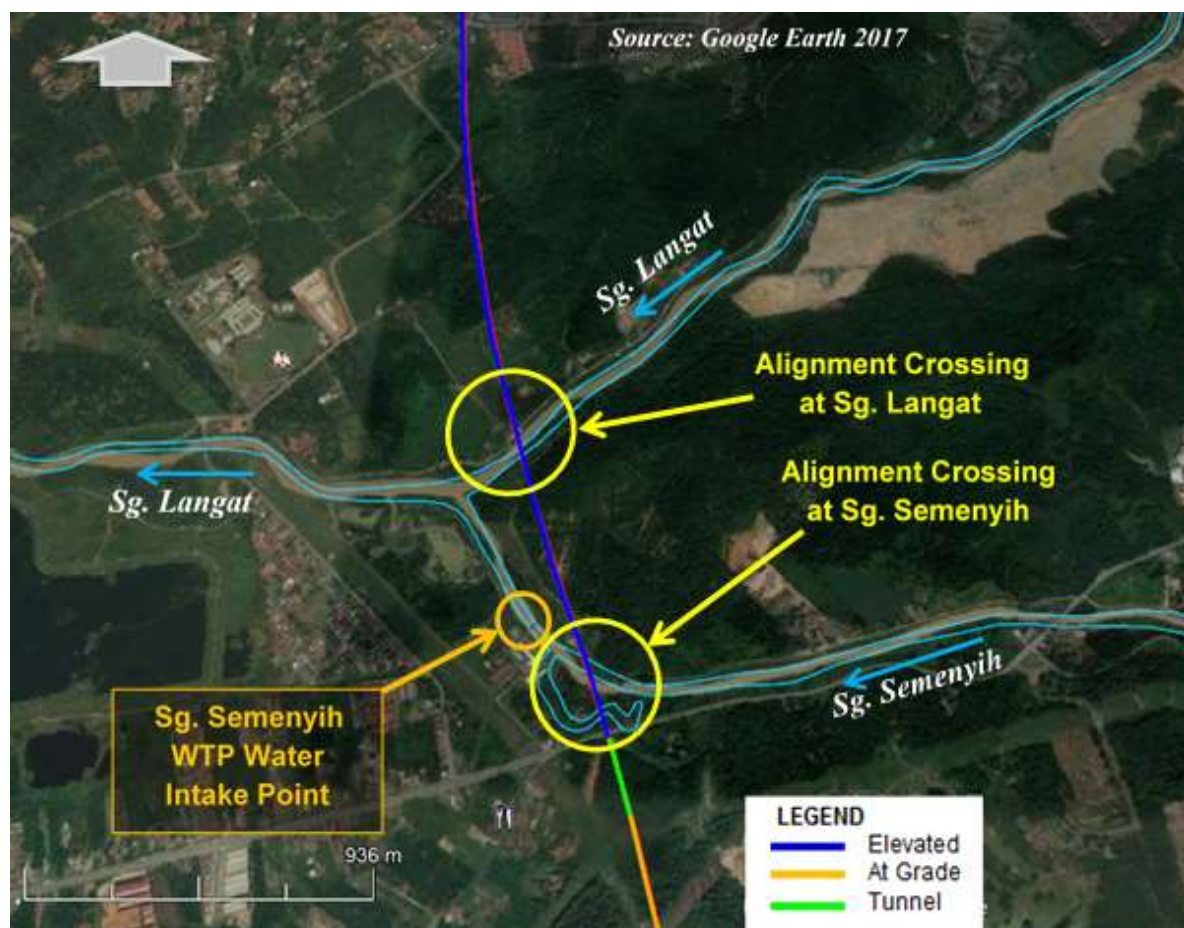


Figure 7-49: Location of Alignment Crossings at Sg. Langat and Sg. Semenyih

Alignment Crossing at Sg. Semenyih

The crossing of the alignment on Sg. Semenyih is located at the coordinates of 02.8902472° N, 101.7378889° E. Sg. Semenyih joins with Sg. Langat immediately downstream of the alignment crossing. Sg. Semenyih water intake is located just beside (downstream) of the alignment crossing. **Figure 7-49** shows the location of the study area.

Results of the soil erosion assessment in FT. Kuala Lumpur- FT. Putrajaya – Selangor are summarised in **Table 7-27**.

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Table 7-27: Summary of Soil Erosion Assessment in FT. Kuala Lumpur- FT. Putrajaya – Selangor

| DETAILS | COORDINATES | DRAINAGE BASIN | PRE-DEVELOPMENT STAGE | | PRE-BULK GRADING STAGE (WITHOUT MITIGATION MEASURES) | | PRE-BULK GRADING STAGE (WITH MITIGATION MEASURES) | | POST BULK GRADING STAGE (WITH MITIGATION MEASURES) | | POST DEVELOPMENT STAGE | | REMARKS |
|---|-----------------------------------|----------------|------------------------------|------------------------|--|------------------------|---|------------------------|--|------------------------|------------------------------|------------------------|--|
| | | | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | |
| Bandar Malaysia Station | 03.1086278° N , 101.6939111° E | Sg. Klang | 0.5 – 33 | 16 | 10 – 657 | 158 | 4 – 263 | 63 | 4 | 19 | 0.5 | 2 | Project site within the catchment area of Sg. Kerayong, a tributary of Sg. Klang |
| Sepang - Putrajaya Station | 02.9460389° N, 101.7329278° E | Sg. Langat | 4 – 381 | 583 | 207 – 2,725 | 6,610 | 83 – 1,090 | 2644 | 29 | 410 | 4 | 51 | Project site is located within catchment area of Sg. Ayer Hitam, a tributary of Sg. Ramal, which flows into Sg. Langat. |
| Light Depot and LMB at Serdang | 02.9901167°N, 101.7340750° E | Sg. Langat | 18 – 623 | 11,998 | 107 – 3,775 | 69,880 | 43 – 1,510 | 27,952 | 34 | 1,879 | 4 | 235 | The northern section of the Project site drains into Sg. Limau Manis on the west, a tributary of Sg. Langat. Site has an undulating to hilly terrain |
| Alignment crossing at Sg. Kerayong | 03.1018722° N, 101.7021778° E | Sg. Klang | 0.4 | 7 | 8.4 | 140 | 3.4 | 56 | 3.4 | 56 | 0.4 | 7 | - |
| Alignment crossing at Sg. Langat | 02.8968556° N, 101.7352917° E | Sg. Langat | 19 | 58 | 184 | 553 | 74 | 221 | 85 | 256 | 22 | 67 | - |
| Alignment crossing at Sg. Semenyih | 02.8902472° N, 101.7378889° E | Sg. Langat | 10 – 26 | 108 | 95 – 145 | 720 | 38 – 58 | 288 | 69 – 105 | 527 | 5 – 18 | 71 | Downstream of Sg. Semenyih WTP & Water Intake |

For Bandar Malaysia Station construction, during post bulk grading, soil loss volume is estimated to be 19 tonne/year. Upon completion, the soil loss is reduced to 2 tonne/year while for Sepang-Putrajaya Station construction, during post bulk grading, soil loss volume is estimated to decrease to 410 tonne/year and is expected to be reduced to 51 tonne/year upon completion. Upon completion of Light depot and LMB construction, the the soil loss is reduced to 235 tonne/year from 1,879 tonne/year.

For the alignment crossing at Sg. Kerayong, the soil loss volume is expected to be the same during post bulk grading stage due to the relatively flat terrain and upon completion, the soil loss is reduced to 7 tonne/year. Meanwhile for the alignment crossing at Sg. Langat, soil loss volume is estimated to increase to 256 tonne/year due to higher K Factor (soil erodibility factor) during post bulk grading. Upon completion, the soil loss is reduced to 67 tonne/year. The soil loss is reduced from 527 tonne/year due to higher K Factor, to 71 tonne/year for the crossing at Sg. Semenyih.

B) Negeri Sembilan

Seremban Station

Seremban Station is located at the coordinates of 02.7436750° N, 101.8041583° E. Seremban Station is located within the catchment area of Sg Jijan. Sg. Jijian joins with Sg. Serdang and then flows into Sg. Chinchang, which then merges with Sg. Batang Labu into Sg. Labu. Sg. Labu is a tributary of Sg. Langat. There is a water intake point at Sg. Labu. **Figure 7-50** shows the location of the study area.



Figure 7-50: Location of Alignment Crossings at Seremban Station and Crossings of Sg. Labu

Alignment Crossing at Sg. Batang Labu

The crossing of the alignment on Sg. Batang Labu is located at the coordinates 02.7913111° N, 101.7582944° E. Sg. Batang Labu joins with Sg. Labu just downstream of the alignment crossing. Sg. Labu is a tributary of Sg. Langat. Sg. Labu Water Intake is located approximately 3 km downstream of the alignment crossing. **Figure 7-51** shows the location of the study area.



Figure 7-51: Location of Alignment Crossing Sg. Batang Labu

Alignment Crossing at Sg. Lukut Besar

The crossing of the alignment on Sg. Lukut Besar is located at the coordinates of 02.6648139° N, 101.8511083°E. **Figure 7-52** shows the location of the study area.



Figure 7-52: Location of Alignment Crossing Sg. Lukut Besar

Alignment Crossing at Sg. Linggi

The crossing of the alignment on Sg. Linggi is located at the coordinates of 02.4215306°N, 102.0210278° E. Sg. Linggi is the boundary line between Negeri Sembilan and Melaka.

Figure 7-53 shows the location of the study area



Figure 7-53: Location of Alignment Crossing Sg. Linggi.

Results of the soil erosion assessment in Negeri Sembilan are summarised in **Table 7-28**.

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Table 7-28: Summary of Soil Erosion Assessment in Negeri Sembilan

| DETAILS | COORDINATES | DRAINAGE BASIN | PRE-DEVELOPMENT STAGE | | PRE-BULK GRADING STAGE (WITHOUT MITIGATION MEASURES) | | PRE-BULK GRADING STAGE (WITH MITIGATION MEASURES) | | POST BULK GRADING STAGE (WITH MITIGATION MEASURES) | | POST DEVELOPMENT STAGE | | REMARKS |
|--|------------------------------|-----------------------------------|------------------------------|------------------------|--|------------------------|---|------------------------|--|------------------------|------------------------------|------------------------|--|
| | | | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | |
| Seremban Station | 02.7436750°N, 101.8041583° E | Sg. Jijan. | 21 – 174 | 1618 | 149 – 1241 | 11559 | 59 – 496 | 4624 | 24 | 411 | 3 | 51 | Undulating to hilly terrain of the Project site. Station is located within the catchment area of Sg Jijan. Sg. Jijan joins with Sg. Serdang and then flows into Sg. Chinchang, which then merges with Sg. Batang Labu into Sg. Labu. Sg. Labu is a tributary of Sg. Langat. There is a water intake point at Sg. Labu |
| Alignment crossing at Sg. Batang Labu (which shares the catchment with Selangor) | 02.7913111° N 101.7582944° E | Sg. Labu, tributary of Sg. Langat | 49 – 189 | 1072 | 246 – 946 | 5362 | 93 – 378 | 2145 | 67 – 69 | 611 | 34 – 35 | 306 | |
| Alignment crossing at Sg. Lukut Besar | 02.6648139°N 101.8511083°E | | 36 | 1292 | 194 | 6985 | 78 | 2794 | 27 | 974 | 1.4 | 49 | |
| Alignment crossing at Sg. Linggi (which shares the catchment with Melaka) | 02.4215306°N 102.0210278°E | Sg. Linggi | 16 -164 | 1141 | 82 – 820 | 5707 | 33 – 328 | 2283 | 36 – 92 | 1203 | 2 – 5 | 60 | |

Soil loss volume of Seremban Station is moderate to high (59 - 496 tonne/ha/year) during the earthwork stage. Soil loss volume is estimated to decrease to 411 tonne/year and upon completion, the soil loss is reduced to 51 tonne/year. For alignment crossing at Sg. Batang Labu, the soil loss is reduced to 306 tonne/year upon completion of construction. During post bulk grading, soil loss volume at alignment crossing at Sg. Lukut Besar is estimated to decrease to 974 tonne/year due to land. Upon completion, the soil loss is reduced to 49 tonne/year. Erosion risk of the Sg. Linggi crossing is moderate to high (33 - 328 tonne/ha/year) during the construction stage, thus during post bulk grading the soil loss volume is estimated to be 1,203 tonne/year and will be reduced upon completion to 60 tonne/year.

C) Melaka

Melaka Station

Melaka Station is located at the coordinates of 02.2965722°N 102.3049861°E. Melaka Station is located within the catchment area of Anak Ayer Padang Keladi. Anak Air Padang Keladi is a tributary of Sg. Durian Tunggal. Sg. Durian Tunggal then flows into Sg. Melaka. Durian Tunggal Water Intake is located immediately downstream of the alignment crossing. **Figure 7-54** shows the location of the study area.



Figure 7-54: Location of Melaka Station, Alignment Crossings of Sg. Durian Tunggal and Sg. Melaka

Alignment Crossing at Sg. Linggi

The crossing of the alignment on Sg. Linggi is located at the coordinates of 02.4215306° N, 102.0210278°E. Sg. Linggi is the boundary line between Negeri Sembilan and Melaka.

Figure 7-55 shows the location of the study area.



Figure 7-55: Location of Alignment Crossing Sg. Linggi

Alignment Crossing at Sg. Melaka and Sg. Durian Tunggal

The crossings of the alignment on Sg. Melaka and Sg. Durian Tunggal are located at the coordinates of 02.3060778°N 102.2669111°E and 02.3085000°N 102.2560111°E respectively. Sg. Durian Tunggal flows into Sg. Melaka immediately downstream of the alignment crossing. Durian Tunggal water intake point is located about 1 km downstream of the alignment crossing. **Figure 7-53** shows the location of the study area.

Alignment Crossing at Sg. Ayer Panas

The crossing of the alignment on Sg. Ayer Panas is located at the coordinates of 02.2744972°N 102.3662306°E. Sg. Ayer Panas flows into Sg. Ayer Molek before discharging into the Straits of Malacca. **Figure 7-56** shows the location of the study area.

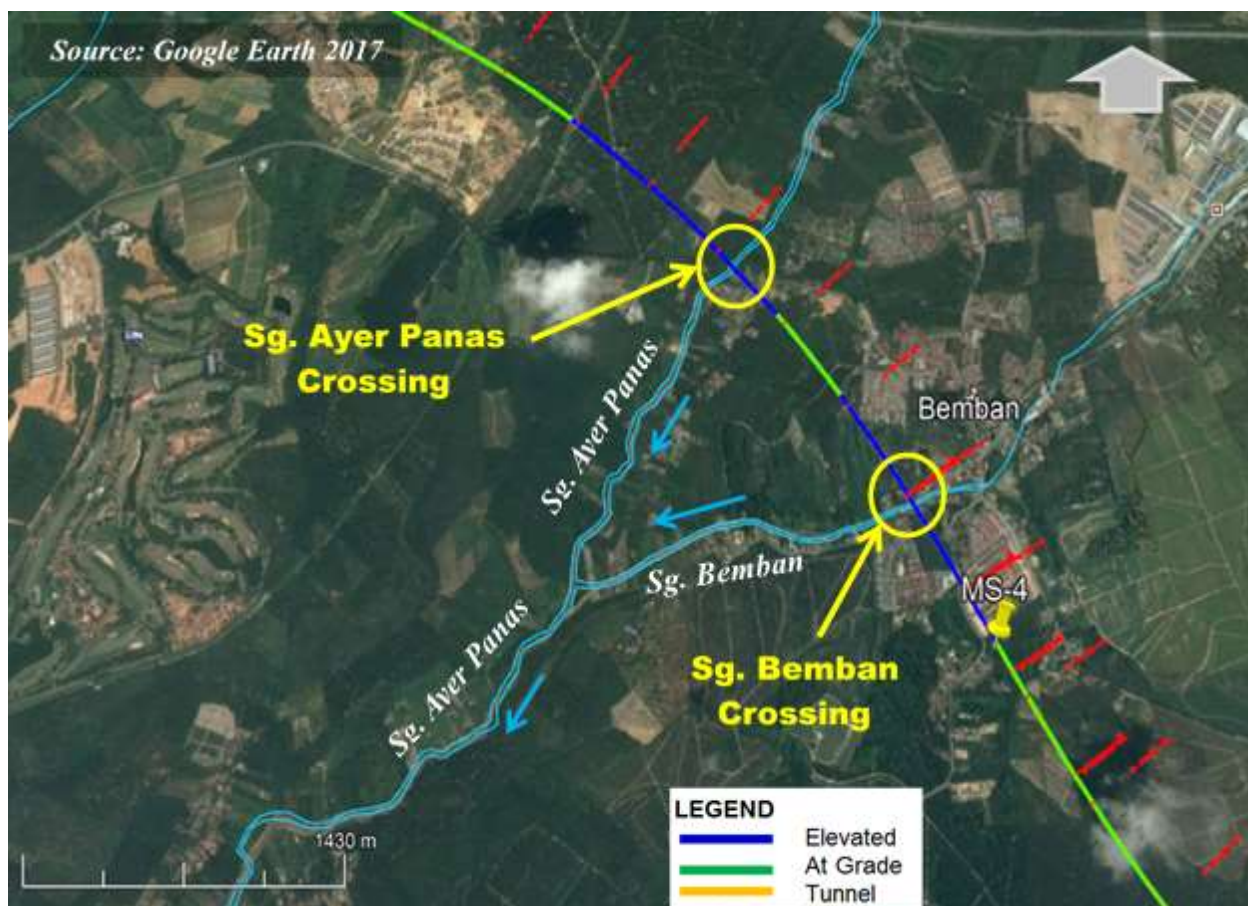


Figure 7-56: Location of Alignment Crossing Sg. Ayer Panas and Sg. Bemban.

Alignment Crossing at Sg. Bemban

The crossing of the alignment on Sg. Bemban is located at the coordinates of 02.2641306°N 102.3740667°E. Sg. Bemban is a tributary of Sg. Ayer Panas while Sg. Ayer Panas is a tributary of Sg. Ayer Molek. **Figure 7-56** shows the location of the study area.

Alignment Crossing at Sg. Kesang

The crossing of the alignment on Sg. Kesang is located at the coordinates of 02.2041250°N 102.4710417°E. Sg. Kesang is the boundary line between Johor and Melaka. Sg. Kesang/ Lanchang WTP Intake point is located approximately 1 km downstream of the alignment crossing. **Figure 7-57** shows the location of the study area.



Figure 7-57: Location of Alignment Crossing Sg. Kesang.

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Table 7-29: Summary of Soil Erosion Assessment in Melaka

| DETAILS | COORDINATES | DRAINAGE BASIN | PRE-DEVELOPMENT STAGE | | PRE-BULK GRADING STAGE (WITHOUT MITIGATION MEASURES) | | PRE-BULK GRADING STAGE (WITH MITIGATION MEASURES) | | POST BULK GRADING STAGE (WITH MITIGATION MEASURES) | | POST DEVELOPMENT STAGE | | REMARKS |
|--|---|---|------------------------------|------------------------|--|------------------------|---|------------------------|--|------------------------|------------------------------|------------------------|--|
| | | | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | |
| Melaka Station | 02.2965722°N 102.3049861°E | Located within the catchment area of Anak Ayer Padang Keladi, a tributary of Sg. Durian Tunggal | 14 – 759 | 1417 | 92 – 5419 | 10050 | 37 – 2168 | 4020 | 25 | 392 | 3 | 49 | Site located at an undulating terrain at the oil palm plantation portion |
| Alignment crossing at Sg. Linggi (which shares the catchment with Negeri Sembilan) | 02.4215306°N 102.0210278°E | Sg. Linggi | 17 – 164 | 1141 | 82 – 820 | 5707 | 33 – 328 | 2283 | 36 – 92 | 1203 | 2 – 5 | 60 | |
| Alignment crossing at Sg. Durian Tunggal and Sg. Melaka | 02.3060778°N 102.2669111°E, 02.3085000°N 102.2560111°E | Sg. Durian Tunggal and Sg. Melaka | 17 | 59 | 112 | 392 | 45 | 157 | 45 | 157 | 17 | 59 | |
| Alignment crossing at Sg. Ayer Panas | 02.2744972°N 102.3662306°E | Sg. Ayer Molek | 59 | 296 | 252 | 1259 | 100 | 504 | 48 | 242 | 28 | 142 | |
| Alignment crossing at Sg. Bemban | 02.2641306°N 102.3740667°E | Sg. Ayer Panas | 39 | 254 | 223 | 1452 | 89 | 581 | 68 | 441 | 30 | 193 | |
| Alignment crossing at Sg. Kesang (which shares the catchment with Johor) | 02.2041250°N 102.4710417°E | Sg. Kesang | 13 – 130 | 1386 | 63 – 926 | 9177 | 25 – 370 | 3671 | 34-38 | 1062 | 2 – 18 | 375 | |

The erosion risk of Melaka Station is moderate to high (37 – 1,268 tonne/ha/year) during land clearing and earthwork stage due to the undulating terrain at the oil palm plantation portion. However, upon completion of the construction the soil loss is estimated to be reduced to 49 tonne/year. Meanwhile for Sg. Linggi, the soil loss volume is expected to be reduced to 60 tonne/year compared to 1,203 during the post bulk grading.

For alignment crossing at Sg. Melaka and Sg. Durian Tunggal the soil loss is expected to be 9 tonne/year as the erosion risk at the river crossings is expected to be moderate (45 tonne/ha/year).

For alignment crossing at Sg. Ayer Panas, during post bulk grading, soil loss volume is estimated to increase to 242 tonne/year and upon completion, the soil loss is reduced to 142 tonne/year. Soil loss volume is estimated to decrease to 441 tonne/year and upon completion, the soil loss is reduced to 193 tonne/year for crossing at Sg. Bemban. During post bulk grading, soil loss volume at the alignment crossing at Sg. Kesang is estimated to be 1,062 tonne/year. Upon completion of the viaduct construction, the soil loss is reduced to 375 tonne/year.

D) Johor

Muar Station

Muar Station is located at the coordinates of 02.1640556° N 102.7310083° E. It is located within the catchment area of Sg. Muar. **Figure 7-58** shows the location of the study area.

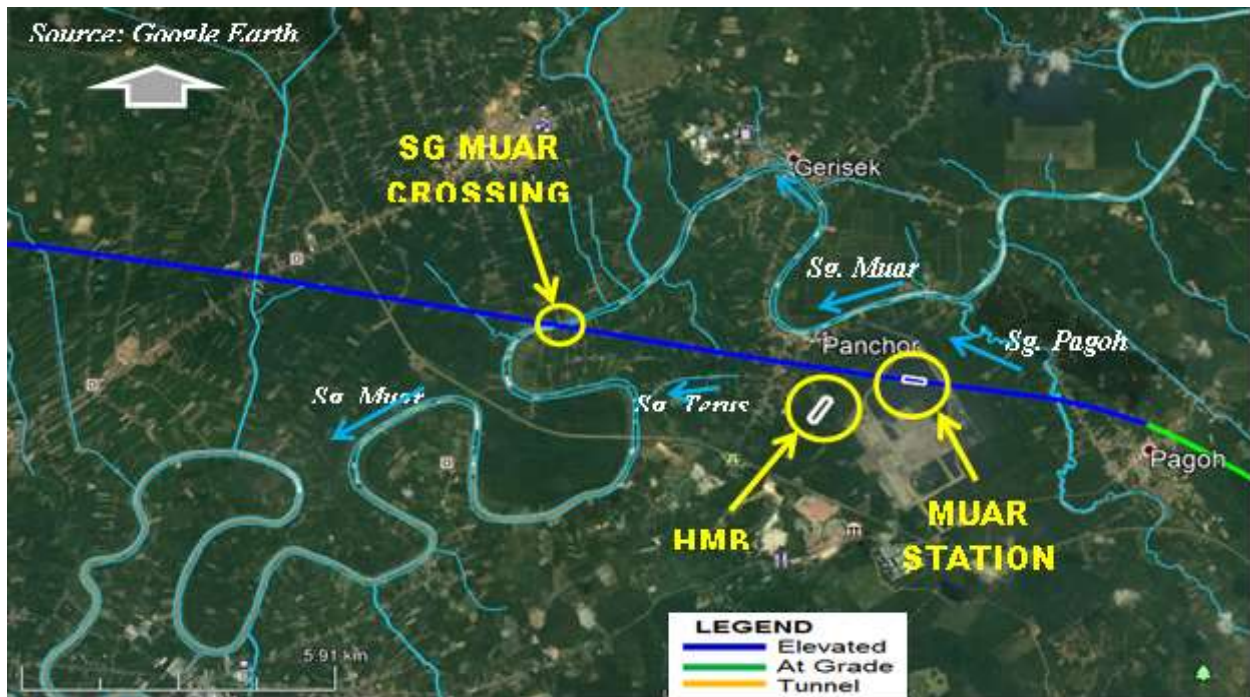


Figure 7-58: Location of Muar Station, HMB and Sg. Muar Crossing.

Batu Pahat Station

Batu Pahat Station is located at the coordinates of 01.8496472°N, 103.0191972°E. Batu Pahat Station is located within the catchment area of Sg. Simpang Kanan, which flows into Sg. Simpang Kiri that then flows into the Straits of Malacca. **Figure 7-59** shows the location of the study area.

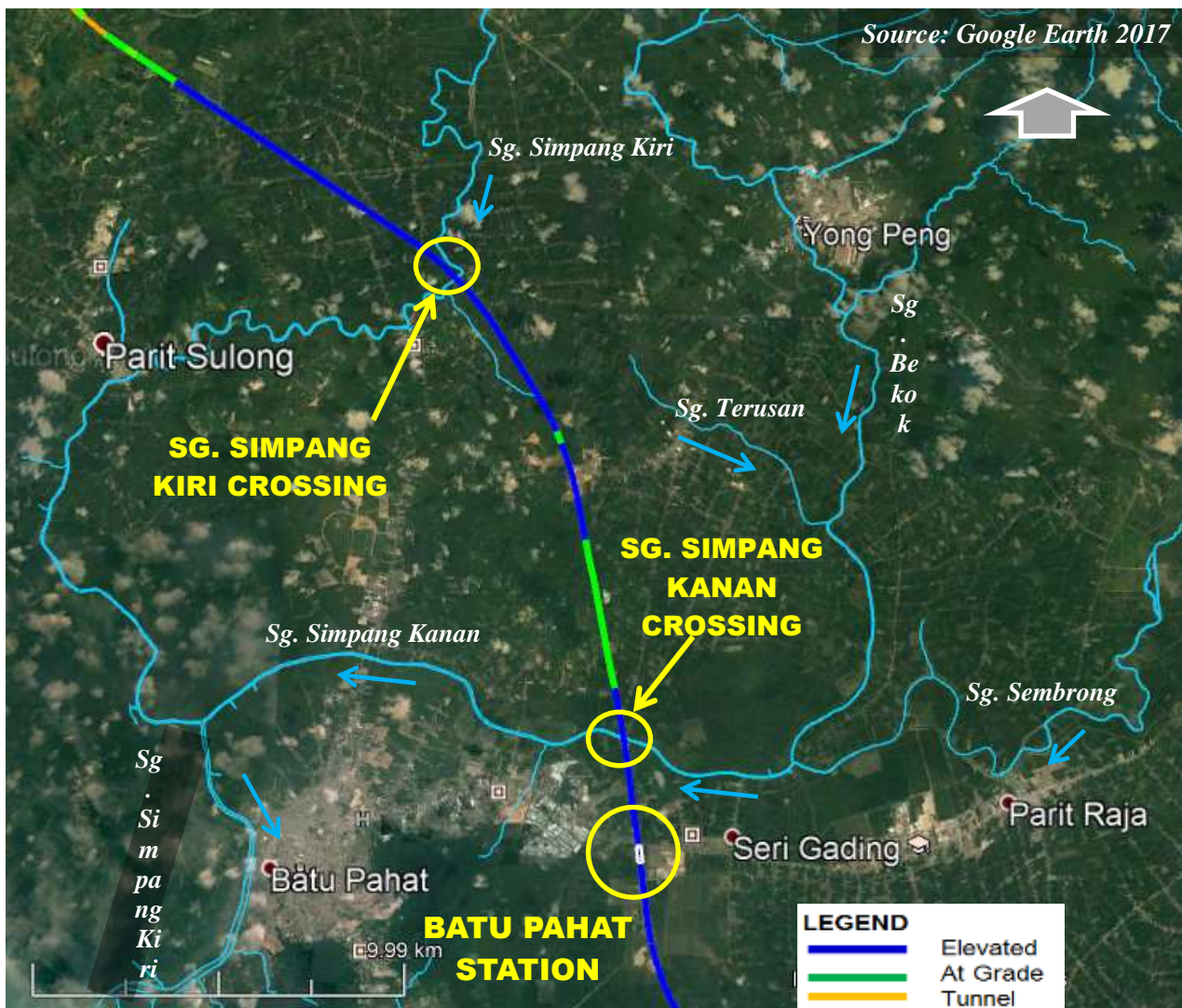


Figure 7-59: Location of Batu Pahat Station, Alignment Crossings of Sg. Simpang Kanan and Sg. Simpang Kiri.

Iskandar Puteri Station

Iskandar Puteri Station is located at the coordinates of 01.4149611°N, 103.5798556°E. Iskandar Puteri Station is located within the catchment area of Sg. Arang, which flows into Sg. Tiram Duku. Sg. Tiram Duku is a small tributary of Sg. Pulai at the lower reach. **Figure 7-60** shows the location of the study area.

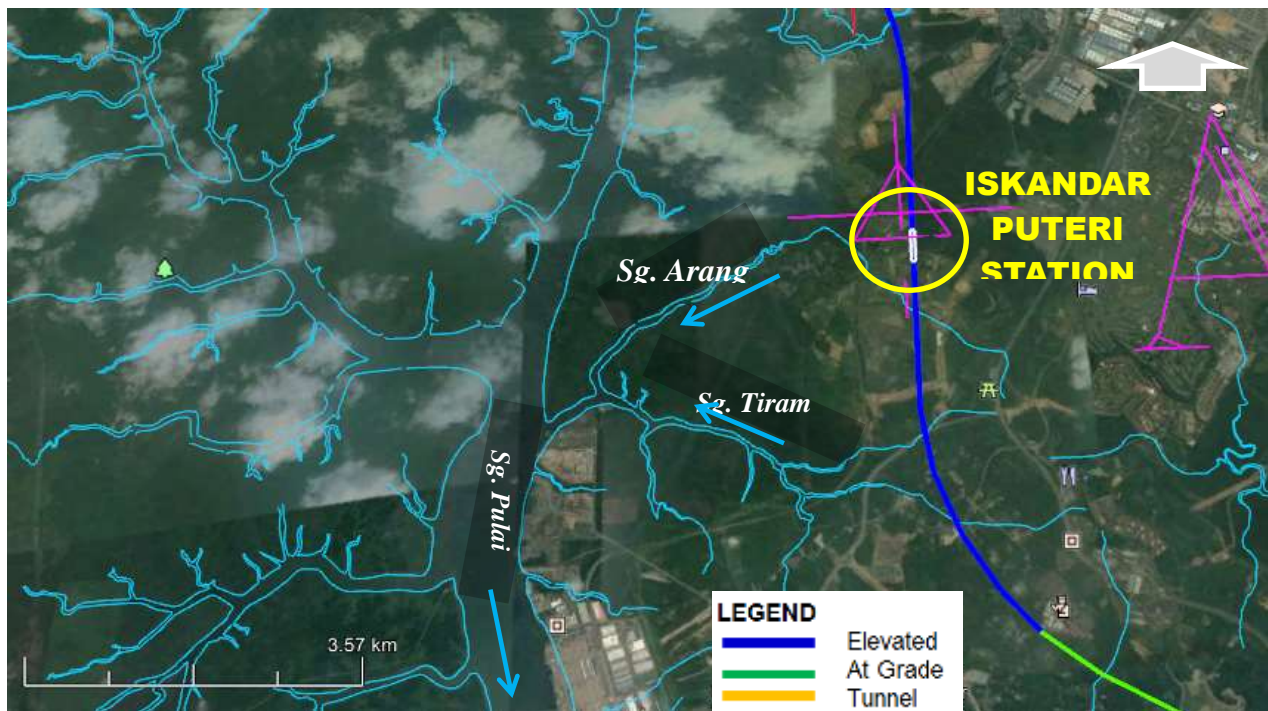


Figure 7-60: Location of Iskandar Puteri Station.

Main Depot and LMB

Main Depot & LMB is located at the coordinates of 01.5098556°N 103.5358333°E near Pekan Nenas, Pontian. It is located within the catchment area of Sg. Jeram Choh, which flows into Sg. Ulu Choh. Sg. Ulu Choh is a small tributary of Sg. Pulai. **Figure 7-61** shows the location of the study area.

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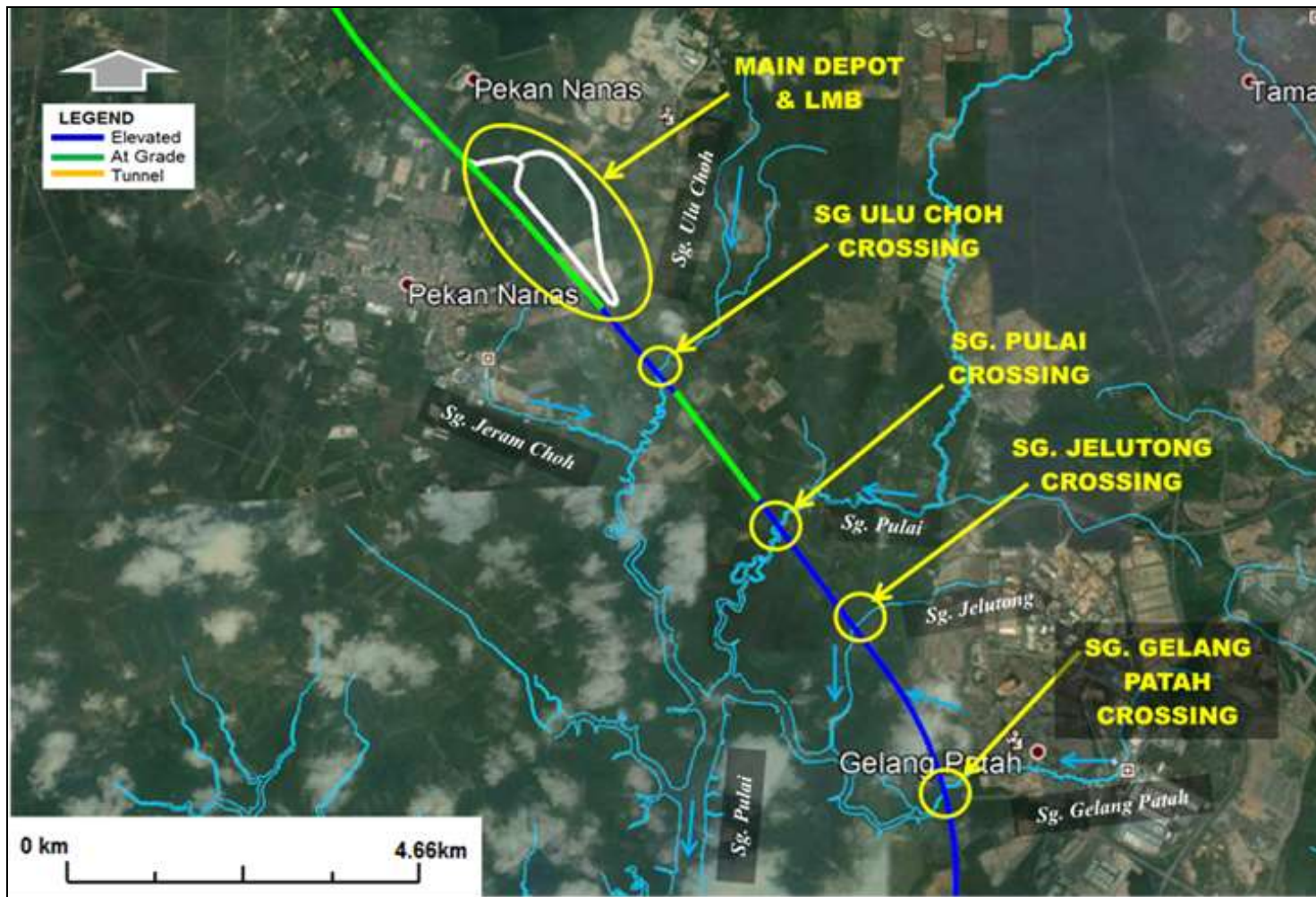


Figure 7-61: Location of Main Depot & LMB, Alignment Crossings of Sg. Ulu Choh, Sg. Pulai, Sg. Jelutong and Sg. Gelang Patah.

Heavy Maintenance Base (HMB)

HMB is located at the coordinates of 02.1605389°N 102.7146333°E. It is located within the catchment area of Sg. Muar. **Figure 7-61** shows the location of the study area.

Alignment Crossing at Sg. Kesang

The crossing of the alignment on Sg. Kesang is located at the coordinates of 02.2041250°N 102.4710417°E. Sg. Kesang is the boundary line between Johor and Melaka. Sg. Kesang Water Treatment Plant and Intake point is located 1 km downstream of the alignment crossing. **Figure 7-62** shows the location of the study area.

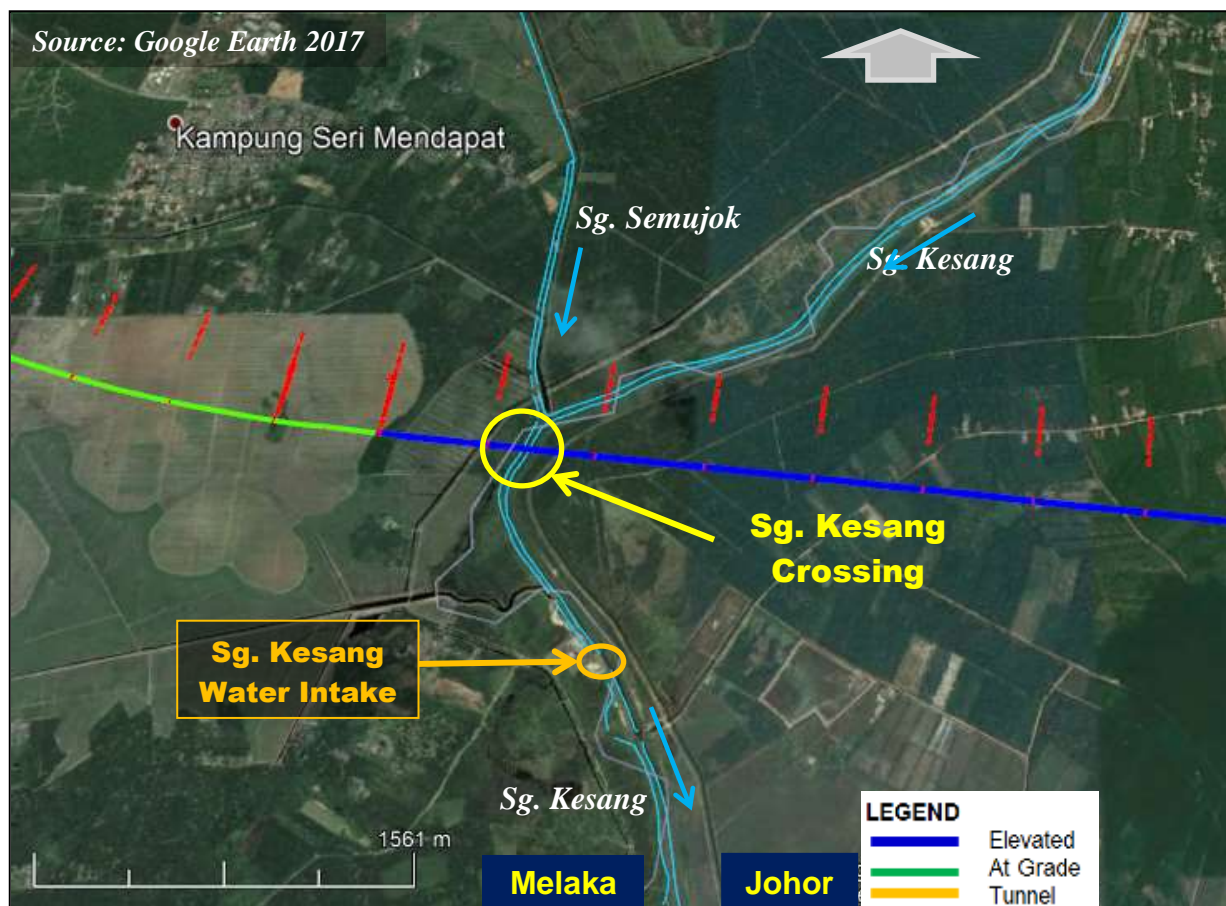


Figure 7-62: Location of Alignment Crossing at Sg. Kesang

Alignment Crossing at Sg. Muar

The crossing of the alignment on Sg. Muar is located at the coordinates of 02.1753278°N 102.6683028°E via viaduct. Sg. Muar flows directly into the Straits of Malacca. **Figure 7-58** shows the location of the study area.

Alignment Crossing at Sg. Simpang Kiri

The crossing of the alignment on Sg. Simpang Kiri is located at the coordinates of 1° 35' 01.5898194°N 103.4889306°E via viaduct near Batu Pahat. Sg. Simpang Kiri joins with Sg. Simpang Kanan downstream and flows to the Straits of Malacca. **Figure 7-59** shows the location of the study area.

Alignment Crossing at Sg. Simpang Kanan

The crossing of the alignment on Sg. Simpang Kanan is located at the coordinates of 01.8807556°N 103.0137139°E via viaduct near Batu Pahat. Sg. Simpang Kanan is the tributary of Sg. Simpang Kiri. **Figure 7-59** shows the location of the study area.

Alignment Crossing at Sg. Pontian Besar

The crossing of the alignment on Sg. Pontian Besar is located at the coordinates of 01.6636167°N 103.4751944°E. The rest of the alignment is At-Grade (fill). Ulu Sg. Pontian Besar merges with Sg. Pontian Besar immediately upstream of the alignment crossing. **Figure 7-63** shows the location of the study area.

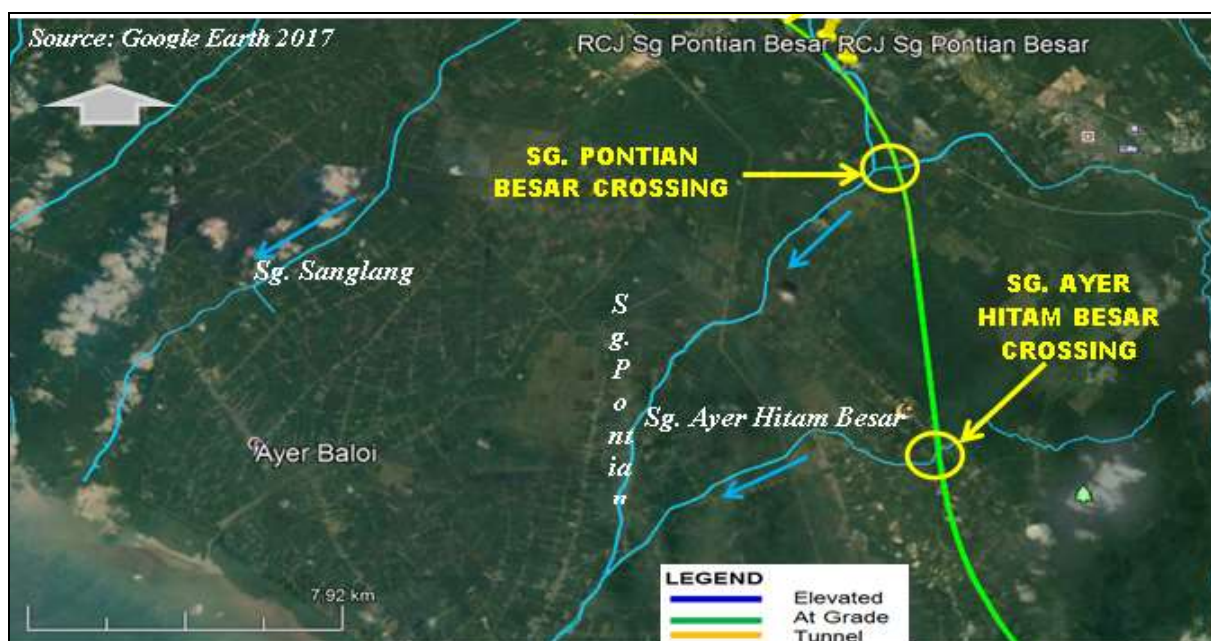


Figure 7-63: Location of Alignment Crossings at Sg. Pontian Besar and Sg. Ayer Hitam Besar.

Alignment Crossing at Sg. Ayer Hitam Besar

The crossing of the alignment on Sg. Ayer Hitam Besar is located at the coordinates of 01.5898194°N 103.4889306°E. The rest of the alignment is At-Grade (fill). Sg. Ayer Hitam Besar is the tributary of Sg. Pontian Besar. **Figure 7-63** shows the location of the study area.

Alignment Crossing at Sg. Ulu Choh

The crossing of the alignment on Sg. Ulu Choh is located at the coordinates of 01.4954861°N 103.5444278°E via viaduct. Sg. Ulu Choh flows into Sg. Pulai. **Figure 7-61** shows the location of the study area.

Alignment Crossing at Sg. Pulai

The crossing of the alignment on Sg. Pulai is located at the coordinates of 01.4760694°N 103.5592056°E by long span viaduct. **Figure 7-61** shows the location of the study area.

Alignment Crossing at Sg. Jelutong

The crossing of the alignment on Sg. Jelutong is located at the coordinates of 01.4628639°N 103.5685417°E. Sg. Jelutong is a tributary of Sg. Gelang Patah which flows into Sg. Pulai. **Figure 7-61** shows the location of the study area.

Alignment Crossing at Sg. Gelang Patah

The crossing of the alignment on Sg. Gelang Patah is located at the coordinate of 01.4433417°N 103.5792139° E with Viaduct structure. It is a tributary of Sg. Pulai. **Figure 7-61** shows the location of the study.

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Table 7-30: Summary of Soil Erosion Assessment in Johor

| DETAILS | COORDINATES | DRAINAGE BASIN | PRE-DEVELOPMENT STAGE | | PRE-BULK GRADING STAGE (WITHOUT MITIGATION MEASURES) | | PRE-BULK GRADING STAGE (WITH MITIGATION MEASURES) | | POST BULK GRADING STAGE (WITH MITIGATION MEASURES) | | POST DEVELOPMENT STAGE | | REMARKS |
|---|----------------------------------|-------------------|------------------------------|------------------------|--|------------------------|---|------------------------|--|------------------------|------------------------------|------------------------|---|
| | | | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | |
| Muar Station | 02.1640556° N 102.7310083° E | Sg. Muar | 6.5 | 89 | 32.5 | 445 | 13 | 178 | 12 | 165 | 1.5 | 21 | The Project site is located on a flat land with oil palm trees |
| Batu Pahat Station | 01.8496472° N 103.0191972° E | Sg. Simpang Kanan | 19 | 232 | 62 | 775 | 25 | 310 | 26 | 322 | 3 | 40 | The Project site is located on a flat land which has been cleared. Sparse secondary vegetation has grown |
| Iskandar Puteri Station | 01.4149611°N 103.5798556° E | Sg. Arang | 13 – 145 | 3660 | 92 – 1038 | 25357 | 37 – 415 | 10143 | 24 | 1027 | 3 | 128 | The Project site is located at an undulating terrain area. |
| Main Depot & LMB | 01.5098556°N 103.5358333°E | Sg. Jeram Choh | 16 – 29 | 2573 | 82 – 143 | 12863 | 33 – 57 | 5145 | 26 | 3078 | 3 | 385 | The Project site is located at a relatively flat terrain area |
| Heavy Maintenance Base (HMB) | 02.1605389° N 102.7146333° E | Sg. Muar | 5 – 7 | 65 | 26 – 36 | 325 | 11 – 15 | 130 | 12 | 126 | 2 | 16 | LiDAR contours of the Project site are not available during the course of study. Topography map from JUPEM indicates the Project site is relatively flat with no contours shown. Rough estimation of the elevations is obtained from Google Earth application |
| Alignment crossing at Sg. Kesang (which shares the catchment with Melaka) | 02.2041250° N 102.4710417° E | Sg. Kesang | 13 – 130 | 1386 | 63 – 926 | 9177 | 25 – 370 | 3671 | 34 – 38 | 1062 | 2 – 18 | 375 | |
| Alignment crossing at Sg. Muar | 02.1753278° N, 102.6683028° E | Sg. Muar | 6 – 147 | 15507 | 28 – 2523 | 104933 | 11 – 1009 | 41973 | 11 – 44 | 5443 | 1 – 2 | 1670 | |
| Alignment crossing at Sg. Simpang Kiri | 01.5898194°N 103.4889306° E | Sg. Simpang Kiri | 15 | 179 | 75 | 895 | 30 | 358 | 30 | 358 | 15 | 179 | |
| Alignment crossing at Sg. Simpang Kanan | 01.8807556° N 103.0137139° E | Sg. Simpang Kanan | 6 | 107 | 29 | 534 | 12 | 214 | 12 | 214 | 6 | 107 | |

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| DETAILS | COORDINATES | DRAINAGE BASIN | PRE-DEVELOPMENT STAGE | | PRE-BULK GRADING STAGE (WITHOUT MITIGATION MEASURES) | | PRE-BULK GRADING STAGE (WITH MITIGATION MEASURES) | | POST BULK GRADING STAGE (WITH MITIGATION MEASURES) | | POST DEVELOPMENT STAGE | | REMARKS |
|--|---------------------------------|----------------------|------------------------------|------------------------|--|------------------------|---|------------------------|--|------------------------|------------------------------|------------------------|--|
| | | | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | EROSION RATE (TONNE/HA/YEAR) | SOIL LOSS (TONNE/YEAR) | |
| Alignment crossing at Sg. Pontian Besar | 01.6636167° N 103.4751944° E | Sg. Pontian Besar | 69 – 85 | 2005 | 492 – 605 | 14324 | 197 – 242 | 5730 | 31 – 43 | 812 | 1 – 2 | 30 | |
| Alignment crossing at Sg. Ayer Hitam Besar | 01.5898194° N 103.4889306° E | Sg. Ayer Hitam Besar | 14 – 115 | 839 | 70 – 577 | 4196 | 28 - 231 | 1679 | 26 – 37 | 590 | 1 – 2 | 30 | |
| Alignment crossing at Sg. Ulu Choh | 01.4954861° N 103.5444278° E | Sg. Ulu Choh | 3 – 12 | 130 | 16 – 79 | 846 | 7 - 31 | 339 | 7 – 22 | 244 | 3 – 8 | 95 | The existing land use is oil palm plantation |
| Alignment crossing at Sg. Pulau | 01.4760694°N 103.5592056° E | Sg. Pulau | 8 | 76 | 80 | 721 | 32 | 288 | 32 | 283 | 8 | 74 | |
| Alignment crossing at Sg. Jelutong | 01.4628639° N 103.5685417° E | Sg. Gelang Patah | 16 | 36 | 80 | 180 | 32 | 72 | 31 | 71 | 16 | 35 | |
| Alignment crossing at Sg. Gelang Patah | 01.4433417° N 103.5792139° E | Sg. Gelang Patah | 5.7 | 21 | 38 | 142 | 15 | 57 | 22 | 82 | 8 | 31 | |

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Erosion risk of HMB is low to moderate (11 – 15 tonne/ha/year) and for Muar Station is 13 tonne/ha/year during land clearing and earthwork stage. For Muar Station, during post bulk grading, soil loss volume is estimated to reduce marginally to 165 tonne/year and upon completion, the soil loss is reduced to 21 tonne/year and for HMB the soil loss is reduced to 16 tonne/year upon completion.

For Batu Pahat Station, the soil loss is reduced to 40 tonne/year while for Iskandar Puteri Station, the soil loss is reduced to 128 tonne/year. The erosion risk of Main Depot & LMB is moderate (33 – 57 tonne/ha/year) during land clearing and earthwork stage as the terrain is relatively flat. During post bulk grading, soil loss volume is estimated to reduce to 3,078 tonne/year and upon completion, the soil loss is reduced to 385 tonne/year.

The soil loss for alignment crossing Sg. Kesang, it is the soil loss is the same as stated in the soil and erosion assessment in Melaka. For Sg. Muar, during post bulk grading, soil loss volume is estimated to be 5,443 tonne/year and upon completion, the soil loss is reduced to 1,670 tonne/year.

Soil loss at Sg. Simpang Kiri is expected to be 179 tonne/year from 358 tonne/year during post bulk grading and for Sg. Simpang Kanan, the soil loss is reduced to 107 tonne/year upon completion from 214 tonne/year during the post bulk grading.

Erosion risk of the Sg. Pontian Besar crossing is high (197 – 242 tonne/ha/year) during the earthwork stage. However, upon completion, the soil loss is expected to reduce to 30 tonne/year. For Sg. Ayer Hitam Besar, soil loss volume is estimated to be 590 tonne/year during post bulk grading and reduced to 30 tonne/year upon completion. During post bulk grading, soil loss volume is estimated to be 244 tonne/year for Sg. Ulu Choh and upon completion, the soil loss is reduced to 95 tonne/year. Erosion risk of the Sg. Pulau crossing is moderate (32 tonne/ha/year) during the construction stage and during post bulk grading, soil loss volume is estimated to be 283 tonne/year is reduced to 74 tonne/year upon completion. Th soil loss volume for both Sg. Jelutong and Sg. Gelang Patah is expected to reduce to 35 tonne/ year and 31 tonne/year upon completion.

7.6.2.1.4 Sedimentation Risk Assessment

Methodology

The potential sedimentation rates were calculated using the Modified Universal Soil Loss Equation (MUSLE). The MUSLE equation is shown below:

$$Y = 89.6(V.Q)^{0.56} .K. LS. C. P$$

Where

| | | |
|----|---|--|
| Y | = | Sediment yield for a storm event (tonne) |
| V | = | Volume of runoff for the storm event (m ³) |
| Q | = | Peak flow for the storm event (m ³ /s) |
| K | = | soil erodibility factor |
| LS | = | combined index of slope length and slope steepness |
| C | = | crop management factor |
| P | = | soil conservation practice factor |

The input parameters for MUSLE and the sources of information are summarised in **Table 7-31**:

Table 7-31: Input Parameters of MUSLE Calculation.

| Label | Parameter | Reference Source |
|----------|-------------------------|---|
| V Factor | Runoff Volume | Based on Curve Number and Surface Runoff Method in Guidelines for Erosion and Sediment Control in Malaysia (DID, 2010). |
| Q Factor | Peak Discharge | Based on Rational Method and Urban Stormwater Management Manual for Malaysia 2 nd Edition (2012). |
| K Factor | Soil Erodibility Factor | Based on Soil Reconnaissance Map (Agriculture Dept, 2002) and <i>Guidelines for Erosion and Sediment Control in Malaysia</i> (DID, 2010) for the K Factor with the corresponding Soil Series. Where K Factor is absent in certain soil series, K Factor of another soil series which has the nearest characteristic and soil composition is used. Limited soil test results for the project site are referred. Borehole data is used to determine K Factor. K Factor is calculated based on Tew Equation as stated in |

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| Label | Parameter | Reference Source |
|-----------|--|---|
| | | <i>Guidelines for Erosion and Sediment Control in Malaysia</i> (DID, 2010). |
| LS Factor | Combined index of Slope Length and Slope Steepness | Based on LIDAR contour plans and <i>Guidelines for Erosion and Sediment Control in Malaysia</i> (DID, 2010). |
| C Factor | Crop Management Factor | Based on site visit, land use map, Google map and <i>Guidelines for Erosion and Sediment Control in Malaysia</i> (DID, 2010). |
| P Factor | Soil Conservation Practice Factor | Based on site visit, land use map, Google map and <i>Guidelines for Erosion and Sediment Control in Malaysia</i> (DID, 2010). |

Input data and result of the sediment yield assessment is shown in **Appendix 7H1**.

7.6.2.1.5 Result of Sediment Yield Assessment

Results of the sediment yield assessment are summarised in the following **Tables 7-31 to 7-34**.

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Table 7-32: Sediment Yield Assessment for FT. Kuala Lumpur, Selangor and FT. Putrajaya

| DETAILS | COORDINATES | DRAINAGE BASIN | SEDIMENT YIELD (TONNE PER STORM EVENT) | | | | |
|------------------------------------|-----------------------------------|----------------|--|--|---|--|------------------------|
| | | | PRE-DEVELOPMENT STAGE | PRE-BULK GRADING STAGE (WITHOUT MITIGATION MEASURES) | PRE-BULK GRADING STAGE (WITH MITIGATION MEASURES) | POST BULK GRADING STAGE (WITH MITIGATION MEASURES) | POST DEVELOPMENT STAGE |
| Bandar Malaysia Station | 03.1086278° E , 101.6939111° N | Sg. Klang | 0.31 | 1.61 | 0.64 | 0.22 | 0.05 |
| Bangi – Putrajaya Station | 02.9460389° N, 101.7329278° E | Sg. Langat | 10 | 219 | 87 | 15 | 2 |
| Light Depot and LMB at Serdang | 02.9901167°N, 101.7340750° E | Sg. Langat | 271 | 3297 | 1319 | 87 | 15 |
| Alignment crossing at Sg. Kerayong | 03.1018722° N, 101.7021778° E | Sg. Klang | 0.31 | 2.21 | 0.88 | 0.88 | 0.02 |
| Alignment crossing at Sg. Langat | 02.8968556° N, 101.7352917° E | Sg. Langat | 0.7 | 15 | 10 | 7 | 0.2 |
| Alignment crossing at Sg. Semenyih | 02.8902472° N, 101.7378889° E | Sg. Langat | 10 | 69 | 27 | 50 | 0.4 |

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Table 7-33: Sediment Yield Assessment for Negeri Sembilan

| DETAILS | COORDINATES | DRAINAGE BASIN | SEDIMENT YIELD (TONNE PER STORM EVENT) | | | | |
|--|---------------------------------|-----------------------------------|--|--|---|--|------------------------|
| | | | PRE-DEVELOPMENT STAGE | PRE-BULK GRADING STAGE (WITHOUT MITIGATION MEASURES) | PRE-BULK GRADING STAGE (WITH MITIGATION MEASURES) | POST BULK GRADING STAGE (WITH MITIGATION MEASURES) | POST DEVELOPMENT STAGE |
| Seremban Station | 02.7436750°N, 101.8041583° E | Sg. Jijan. | 32 | 500 | 200 | 18 | 3 |
| Alignment crossing at Sg. Batang Labu (which shares the catchment with Selangor) | 02.7913111° N 101.7582944° E | Sg. Labu, tributary of Sg. Langat | 26 | 225 | 117 | 26 | 1 |
| Alignment crossing at Sg. Lukut Besar | 02.6648139°N 101.8511083°E | | 17 | 162 | 65 | 23 | 0.07 |
| Alignment crossing at Sg. Linggi (which shares the catchment with Melaka) | 02.4215306°N 102.0210278°E | Sg. Linggi | 31 | 273 | 109 | 62 | 0.24 |

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Table 7-34: Sediment Yield Assessment for Melaka

| DETAILS | COORDINATES | DRAINAGE BASIN | SEDIMENT YIELD (TONNE PER STORM EVENT) | | | | |
|--|---|-----------------------------------|--|--|---|--|------------------------|
| | | | PRE-DEVELOPMENT STAGE | PRE-BULK GRADING STAGE (WITHOUT MITIGATION MEASURES) | PRE-BULK GRADING STAGE (WITH MITIGATION MEASURES) | POST BULK GRADING STAGE (WITH MITIGATION MEASURES) | POST DEVELOPMENT STAGE |
| Melaka Station | 02.2965722°N 102.3049861°E | Sg. Anak Ayer Padang Keladi | 39 | 439 | 176 | 18 | 3 |
| Alignment crossing at Sg. Linggi (which shares the catchment with Negeri Sembilan) | 02.4215306°N 102.0210278°E | Sg. Linggi | 31 | 273 | 109 | 62 | 0.24 |
| Alignment crossing at Sg. Durian Tunggal and Sg. Melaka | 02.3060778°N 102.2669111°E, 02.3085000°N 102.2560111°E | Sg. Durian Tunggal and Sg. Melaka | 2.7 | 18.9 | 7.5 | 7.5 | 2.0 |
| Alignment crossing at Sg. Ayer Panas | 02.2744972°N 102.3662306°E | Sg. Ayer Molek | 11 | 68 | 27 | 13 | 0.6 |
| Alignment crossing at Sg. Bemban | 02.2641306°N 102.3740667°E | Sg. Ayer Panas | 10 | 75 | 30 | 23 | 1 |

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| DETAILS | COORDINATES | DRAINAGE BASIN | SEDIMENT YIELD (TONNE PER STORM EVENT) | | | | |
|--|-------------------------------|----------------|--|--|---|--|------------------------|
| | | | PRE-DEVELOPMENT STAGE | PRE-BULK GRADING STAGE (WITHOUT MITIGATION MEASURES) | PRE-BULK GRADING STAGE (WITH MITIGATION MEASURES) | POST BULK GRADING STAGE (WITH MITIGATION MEASURES) | POST DEVELOPMENT STAGE |
| Alignment crossing at Sg. Kesang (which shares the catchment with Johor) | 02.2041250°N 102.4710417°E | Sg. Kesang | 44 | 521 | 208 | 62 | 0.9 |

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Table 7-35: Sediment Yield Assessment for Johor

| DETAILS | COORDINATES | DRAINAGE BASIN | SEDIMENT YIELD (TONNE PER STORM EVENT) | | | | |
|---|---------------------------------|-------------------|--|--|---|--|------------------------|
| | | | PRE-DEVELOPMENT STAGE | PRE-BULK GRADING STAGE (WITHOUT MITIGATION MEASURES) | PRE-BULK GRADING STAGE (WITH MITIGATION MEASURES) | POST BULK GRADING STAGE (WITH MITIGATION MEASURES) | POST DEVELOPMENT STAGE |
| Muar Station | 02.1640556° N 102.7310083° E | Sg. Muar | 1 | 14 | 6 | 5 | 1 |
| Batu Pahat Station | 01.8496472° N 103.0191972° E | Sg. Simpang Kanan | 6 | 39 | 15 | 15 | 3 |
| Iskandar Puteri Station | 01.4149611° N 103.5798556° E | Sg. Arang | 69 | 1005 | 402 | 40 | 7 |
| Main Depot & LMB | 01.5098556° N 103.5358333° E | Sg. Jeram Choh | 75 | 664 | 266 | 159 | 25 |
| Heavy Maintenance Base (HMB) | 02.1605389° N 102.7146333° E | Sg. Muar | 0.7 | 10.2 | 4.1 | 3.9 | 0.7 |
| Alignment crossing at Sg. Kesang (which shares the catchment with Melaka) | 02.2041250° N 102.4710417° E | Sg. Kesang | 44 | 521 | 208 | 62 | 0.9 |
| Alignment crossing at Sg. Muar | 02.1753278° N 102.6683028° E | Sg. Muar | 479 | 6225 | 2490 | 337 | 3 |

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| DETAILS | COORDINATES | DRAINAGE BASIN | SEDIMENT YIELD (TONNE PER STORM EVENT) | | | | |
|--|---------------------------------|----------------------|--|--|---|--|------------------------|
| | | | PRE-DEVELOPMENT STAGE | PRE-BULK GRADING STAGE (WITHOUT MITIGATION MEASURES) | PRE-BULK GRADING STAGE (WITH MITIGATION MEASURES) | POST BULK GRADING STAGE (WITH MITIGATION MEASURES) | POST DEVELOPMENT STAGE |
| Alignment crossing at Sg. Simpang Kiri | 01.5898194°N 103.4889306° E | Sg. Simpang Kiri | 6.1 | 53.6 | 21.4 | 21.4 | 0.4 |
| Alignment crossing at Sg. Simpang Kanan | 01.8807556° N 103.0137139° E | Sg. Simpang Kanan | 1.5 | 20.8 | 8.3 | 8.3 | 0.1 |
| Alignment crossing at Sg. Pontian Besar | 01.6636167° N 103.4751944° E | Sg. Pontian Besar | 27 | 515 | 206 | 30 | 0.07 |
| Alignment crossing at Sg. Ayer Hitam Besar | 01.5898194° N 103.4889306° E | Sg. Ayer Hitam Besar | 21 | 191 | 76 | 27 | 0.1 |
| Alignment crossing at Sg. Ulu Choh | 01.4954861° N 103.5444278° E | Sg. Ulu Choh | 75 | 39.5 | 15.8 | 11.2 | 0.4 |
| Alignment crossing at Sg. Pulai | 01.4760694°N 103.5592056° E | Sg. Pulai | 2.1 | 34.8 | 13.9 | 13.6 | 0.2 |

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| DETAILS | COORDINATES | DRAINAGE BASIN | SEDIMENT YIELD (TONNE PER STORM EVENT) | | | | |
|--|---------------------------------|------------------|--|--|---|--|------------------------|
| | | | PRE-DEVELOPMENT STAGE | PRE-BULK GRADING STAGE (WITHOUT MITIGATION MEASURES) | PRE-BULK GRADING STAGE (WITH MITIGATION MEASURES) | POST BULK GRADING STAGE (WITH MITIGATION MEASURES) | POST DEVELOPMENT STAGE |
| Alignment crossing at Sg. Jelutong | 01.4628639° N 103.5685417° E | Sg. Gelang Patah | 0.8 | 7.4 | 2.9 | 2.9 | 0.1 |
| Alignment crossing at Sg. Gelang Patah | 01.4433417° N 103.5792139° E | Sg. Gelang Patah | 1.1 | 5.7 | 2.3 | 2.3 | 0.2 |

7.6.2.2 Operational Phase

Results from the erosion and sedimentation risk assessment during the operational stage are found to be lower or the same as during pre-development stage.

The stations, depots and maintenance base are mostly built-up with buildings, paved road and infrastructure. Non-built-up areas shall be landscaped with greenery for environmental protection and aesthetic purpose. The erosion and sedimentation risks are very low.

The HSR alignment consists of three (3) types of structure, namely, elevated, at-grade and tunnel. The erosion and sedimentation risks are discussed below:

- Elevated structure - erosion and sedimentation risks will mostly be the same or slightly lower than the pre-development stage. Buildings, roads and small vegetation below the elevated structure shall not be disturbed unnecessarily. Land disturbance to the non-built-up area shall be minimized. Upon completion of construction work, the disturbed area shall be stabilised with turfing, crusher run, concrete or other permanent environmental protection measures.
- At-grade structure - the alignment segments with at-grade structure are usually constructed with cut or fill platforms, which shall be stabilized with turfing, erosion blanket and other P2M2. The erosion and sedimentation risk is assessed to be low.
- Tunnel structure - as extensive earthwork is involved at the tunnel portals, erosion and sedimentation risks can range from low to high due to the extensive cut slopes exposed to abundant rainfall in the long term. Hence, permanent slope protection measures such as erosion blanket, hydroseeding, concrete cover, shotcrete, retaining wall, etc., shall be inspected and maintained on a regular basis.

During the operational stage, all disturbed area shall be stabilized with buildings, infrastructure, green landscape and permanent environmental protection measures such as drainage, turfing, crusher run, concrete cover, retaining wall, etc. The potential erosion and sedimentation impacts are predicted to be low.

7.6.3 Sewage Effluent

7.6.3.1 Construction Phase

During construction phase following are the assumption made for estimated sewage effluent from the Centralized Labour Quarters (CLQ) located at the proposed depots and HMB.

- Total workers each camp: 5,000 nos
- To provide: 4 blocks
- Floor levels: 4 levels
- No of toilet each floor: 21 nos
- Total no of toilet at each camp: 336 nos
- Total estimated PE: 5,040

During construction stage, each quarter will be using approved package STP approved by SPAN. The approved SPAN's package STP system provided at each camp with 5,040 PE and regular maintenance is important to address sewage pollution may raise at this temporary facility. The size of PE may increase based on the works number in the actual facility.

7.6.3.2 Operational Phase

Impacts associated with the discharge of treated effluents to receiving waterways will be a long-term consequence. Untreated or partially treated sewage and wastewater discharges from stations, maintenance depots and train toilets could pollute local streams and rivers and diminish their functional status and resource value; and promote negative public health impacts and degradation of aquatic ecological communities. In the case of sewage treatment there are commercially proven technologies which can remove pollutants to very low levels before release to the environment. The amount of treated sewage effluents that will be discharged by the Project facilities to the environment has been estimated to be relatively low (**Table 7-34**). A majority of the Stations will be located within, or near to, new urban developments, and as such their effluents can be discharged to the latter's sewerage system. This strategy would be more viable, effective and economical than treating the raw sewage flows within the Facility site.

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Table 7-36: Sewage Discharge Estimation

| Total Sewage Generated From Stations and Depots | Population Equivalent | | Sewage Discharge (m ³ /day) | |
|---|-----------------------|---------------|--|--------------|
| | 2030 | 2060 | 2030 | 2060 |
| Bandar Malaysia | 3164 | 7452 | 712 | 1677 |
| Bangi- Putrajaya | 221 | 479 | 50 | 108 |
| Seremban | 1063 | 2718 | 239 | 611 |
| Melaka | 862 | 2128 | 194 | 479 |
| Muar | 342 | 837 | 77 | 188 |
| Batu Pahat | 505 | 1237 | 114 | 278 |
| Iskandar Puteri | 656 | 1628 | 148 | 366 |
| Light Depot + LMB | 180 | | 41 | |
| HMB (Muar) | 180 | | 41 | |
| Main Depot + LMB | 180 | | 41 | |
| Total | 7,354 | 17,019 | 1,657 | 3,830 |

Notes:

- 1) One PE corresponds to 225 litres/ day of Sewage Discharge
- 2) All PE Recommended rates are taken from SPAN's Malaysian Sewerage Industry Guideline, Sewage Treatment Plants, 3rd Edition Volume IV (Table 1.1)
- 3) PE for stations was summed up based on the ridership (passengers), staff, Discharge wastewater from trainset and Ground Floor Area (GFA)
- 4) PE for Discharge wastewater from trainset is calculated by assuming (250 litres x 6 toilets x 50 trainsets)/ 225 litres

It is expected that a majority of Industrial wastewaters generated by the Depots and HMB will be recycled (assumed at about 70 percent). Therefore, the quantities of residual treated effluents discharged to receiving waters will not induce negative water quality shifts that will undermine the water resource potentials of the receiving water way. The recycling-cum-treatment system to be adopted by these facilities can only be confirmed by the PDP. The Project Proponent pledges to the DOE that once details of such systems are confirmed by the PDP, they will be submitted to the DOE for approval in the format and details specified.

Nevertheless, the Project Proponent pledges to the DOE that all measures shall be taken to ensure that the water quality of watercourses receiving treated sewage and industrial wastewaters shall not be adversely affected by the discharges.

7.7 MARINE WATER QUALITY IMPACTS

The HSR alignment over the Tebrau Strait up to the MY-SG International Border will be supported by elevated structures and a bridge that spans across the Main Channel. The principal environmental impacts arising from the implementation of this portion of the HSR alignment will occur during the construction of the Elevated structure and the Bridge; whilst there should be minor environmental impacts induced during the operations phase. The potential impacts relate to water quality and ecological perturbations, impedances to marine traffic and water hydrodynamics.

7.7.1 Construction Phase

The principal construction related activities that are capable of inducing environmental impacts include:

1. Transportation of materials and equipment by Barges
2. Waste/Wastewater Generation during Transportation
3. Piling Works
4. Construction of elevated structures/bridges

The potential impacts that could occur during the construction phase are assessed herewith.

7.7.1.1 Transportation of Materials and Equipment by Barges

A construction platform serviced by barges and service boats will be employed to construct the bridge and elevated structure. Most of the heavy bulk of construction materials will be delivered by these barges. Workers aboard the marine working vessels will generate both sewage and solid wastes. In addition, accidental spillage or leakage of chemicals and fuel / oil into the marine environment from the barges and service boats could occur. If these wastes are discharged without proper treatment to the marine waters, potential water adverse quality impacts could materialize; such as affecting the hygienic water quality of the marine waters, as well as introducing nutrients into the waters that could potentially lead to eutrophication effects. This is especially significant in view of the relative poor hydrodynamics of the Project area (a constricted waterbody with low currents).

Provided mitigation measures are in place, leaks and spills can be kept to a minimum and any discharge can be prevented. Impacts are expected to be temporary, i.e. during the Construction Phase only. Potential impacts are rated as being inconsequential and localized (i.e. within the working boundary only).

7.7.1.2 Piling Works

Impacts wastewater refers to black water and grey water generated by workers on the marine working vessels. Any untreated discharge of sewage or wastewater into the marine environment may affect hygienic water quality as well as introduce nutrients into the waters, potentially leading to eutrophication. This is especially significant with the hydrodynamics of the Project area – a constricted waterbody with low current.

Impact is expected only during construction phase with low degree adverse impact and localized only within the working boundary.

Sedimentation

The key concern from the piling activities is the release of sediments into the marine waterbody, consequently increasing turbidity and thereby impacts on water quality. In the mudflat areas, a cofferdam for each pier will be used to protect the working area totally seven (7) piers altogether. Cofferdams are temporary enclosures to keep out water and soil so as to permit dewatering and construction of the permanent structure in the dry. The construction area will be completely closed by cofferdam, no water can enter to the cofferdam and hence no sediment spill is anticipated outside the cofferdam. The assumptions given in have not been applied for the piers in the mudflat areas, rather zero spill has been assumed for both the piling and the removal of the cofferdams. One cofferdam will be built for each pier/pile cap within the mudflat area (total seven piers). It is envisaged that current changes caused by the cofferdams will be minimal and localised, typically less than 0.02 m/s in average and 0.06 m/s in maximum as illustrated in **Figures 7-64 to 7-69** for all the climatic conditions.

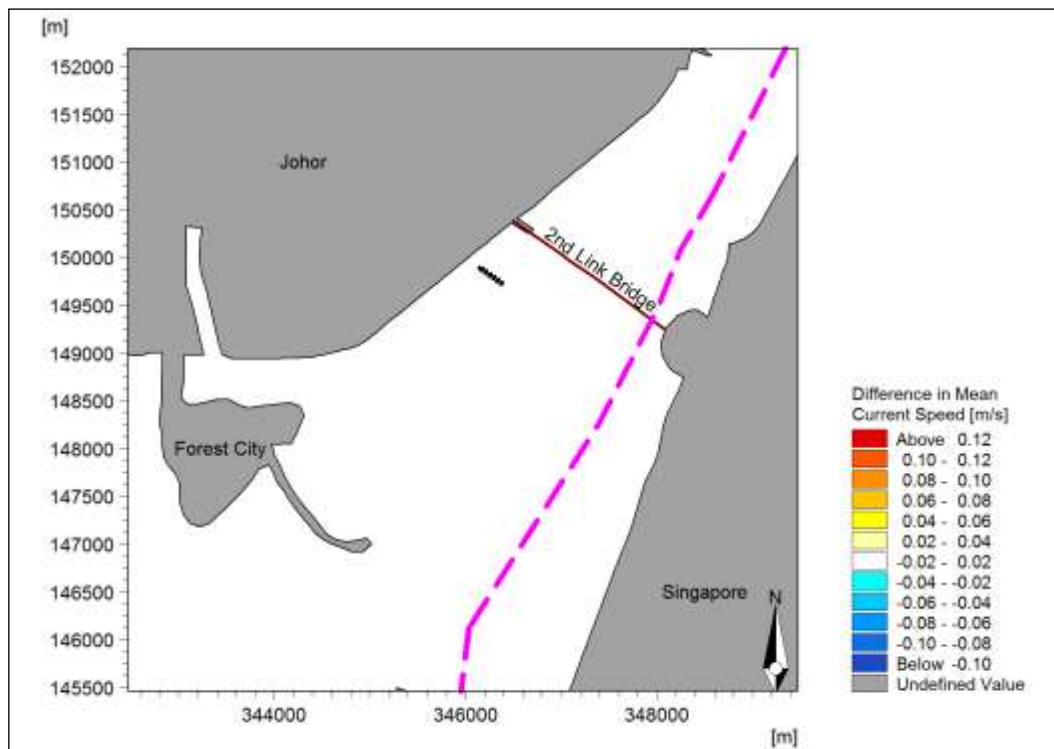


Figure 7-64: Predicted difference in mean current speed during construction phase (Inter-monsoon)

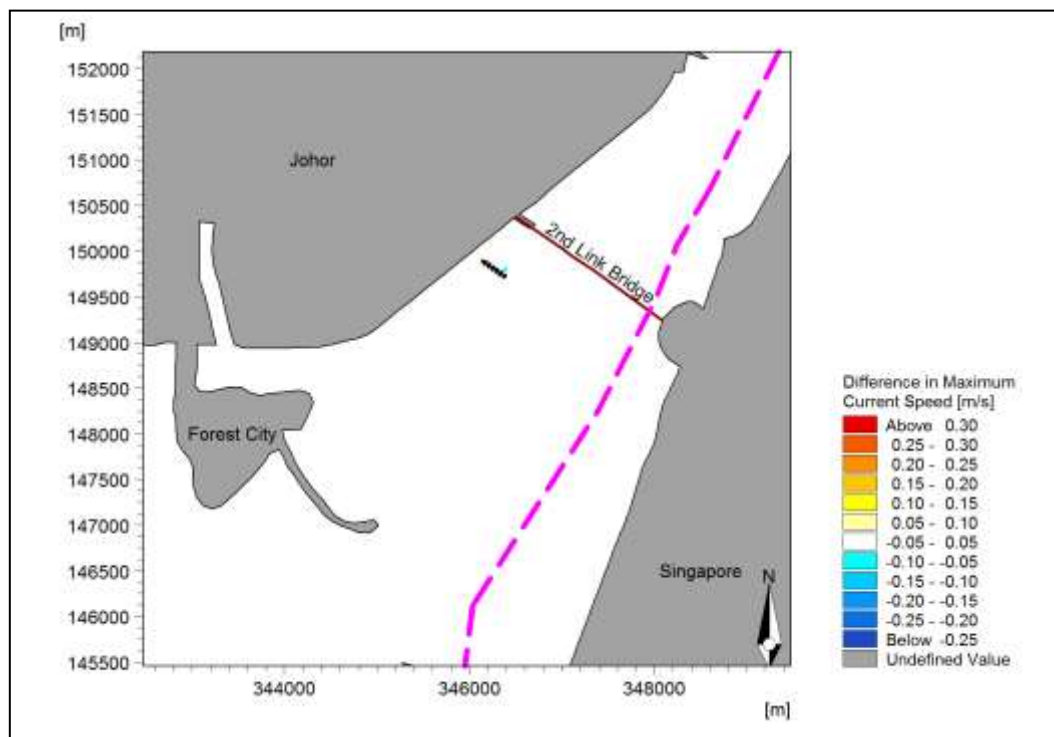


Figure 7-65: Predicted difference in maximum current speed during construction phase (Inter-monsoon)

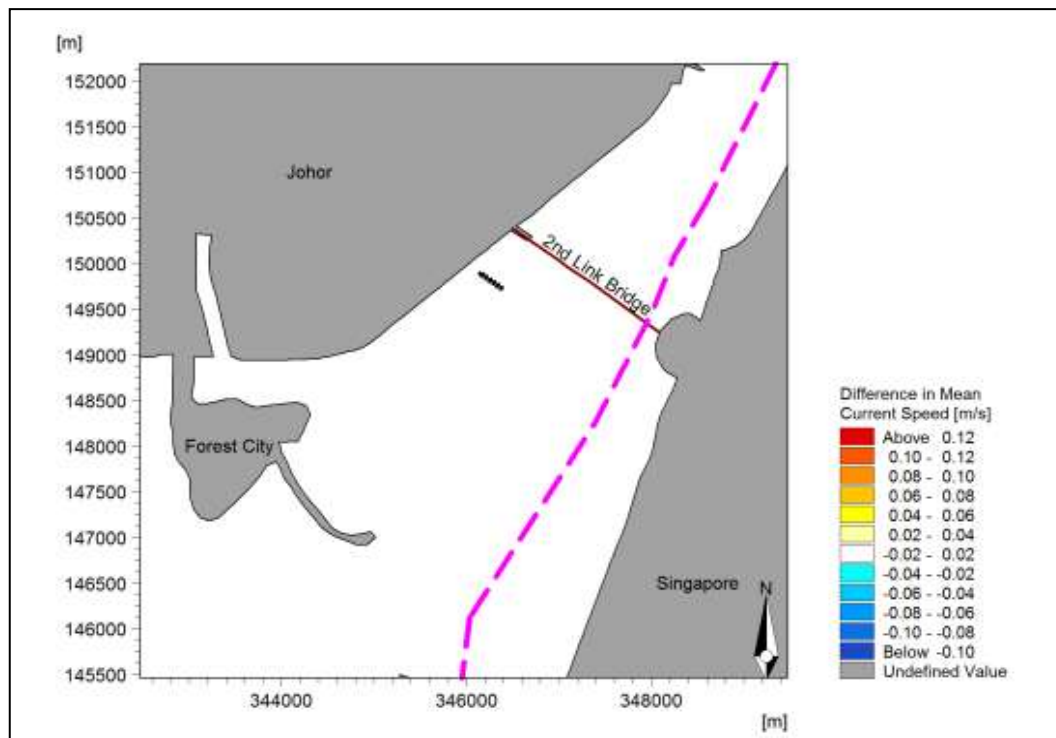


Figure 7-66: Predicted difference in mean current speed during construction phase (Northeast monsoon).

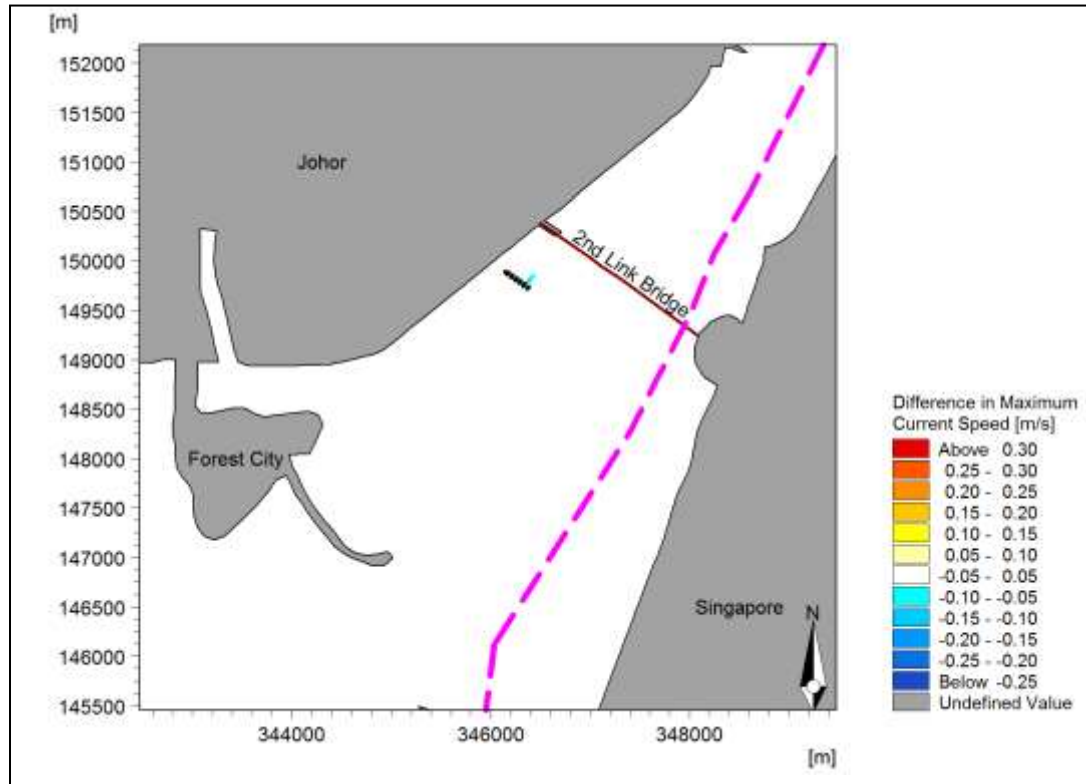


Figure 7-67: Predicted difference in maximum current speed during construction phase (Northeast Monsoon).

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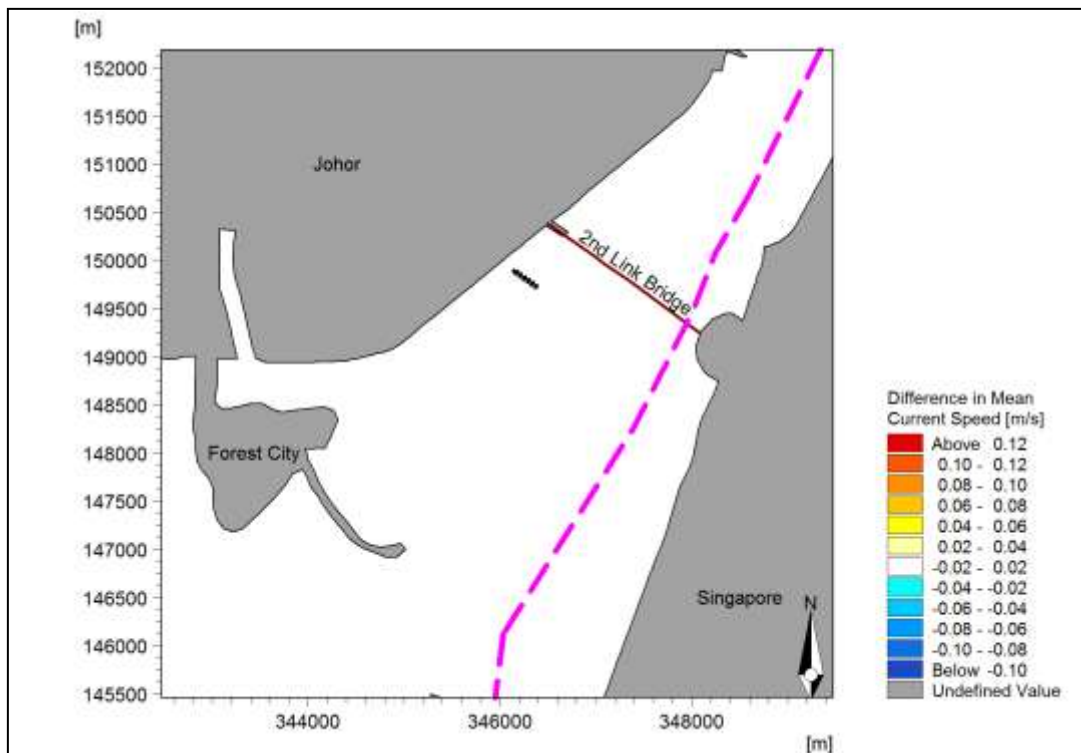


Figure 7-68: Predicted difference in mean current speed during construction phase (Southwest monsoon).

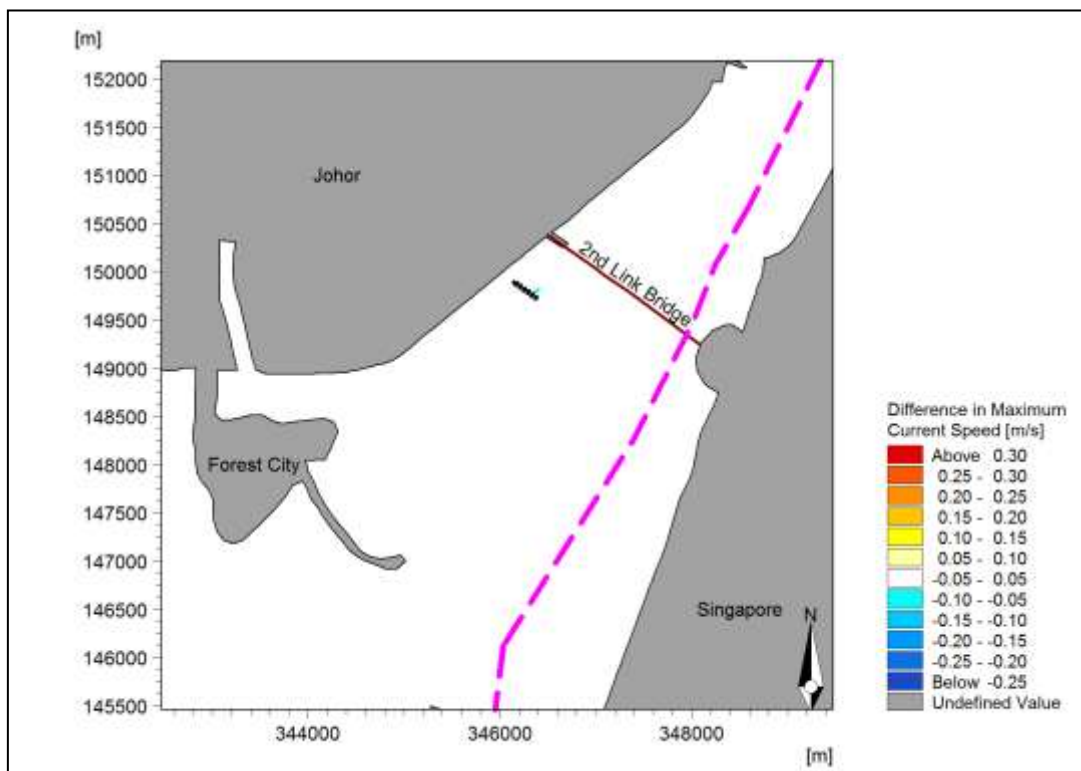


Figure 7-69: Predicted difference in maximum current speed during construction phase (Southwest monsoon).

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Outside of the shallow mudflat areas, where coffer dam construction is impractical, conventional underwater piling operations will be adopted. In order to predict the suspended sediment plumes generated from the piling activities, numerical modelling using MIKE 21 MT was carried out based on the assumptions shown in **Table 7-37**. The plume modeling assumed that construction is carried out concurrently at all four (4) piles and during the NE Monsoon, SW Monsoon and Inter-monsoon climatic scenarios.

To evaluate the impact significance of the predicted sediment plumes from piling, values of 5 mg/L and 10 mg/L are generally used as thresholds (**Table 7-38**). However, as shown in **Figure 7-70**, the maximum suspended sediment plume concentration from the piling activity is predicted to be less than 5 mg/L. In other words, Suspended Solids concentrations above 5 mg/L are not predicted to occur at any time (0% of the time) during the piling works. This is primarily due to the sandy sediments in the project area, which tend to settle quickly instead of being transported or dispersed in a plume.

Table 7-37: Assumptions (worst case) used in the estimation spill rate (for construction of 4 piers per day)

| Parameter | Unit | Details |
|------------------------------------|-------------------|---|
| Number of piles | - | 4 |
| Total number of piles | - | <ul style="list-style-type: none"> 392 piles plus 84 at the navigational span |
| Diameter of Pile | m | <ul style="list-style-type: none"> 1.8 meter (navigational span) 1.5 meter (other piles) |
| Depth of Pile in Seabed | m | 50 |
| Volume to be excavated per pile | m ³ | <ul style="list-style-type: none"> 127 m³ (navigational span) 88 m³ (other piles) |
| Percentage of fines (conservative) | % | 20 |
| Fines spillage | % | 5 |
| Sediment density | kg/m ³ | 2000 |
| Working hours per day | hours | 10 |
| Total spill per day per machine | tonnes | <ul style="list-style-type: none"> 1.3 tonnes (navigational span) 0.9 tonnes (other piles) |
| Estimated time to install one pile | days | 2 |

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Table 7-38: Suspended Sediment Concentration (SSC) Threshold.

| Threshold Value | Assessment Purpose | Description |
|--|-------------------------------|--|
| Exceeds 5 mg/L for more than 10% of the time | Plume visibility ¹ | 5 mg/L is the assumed limit at which the suspended sediments (in excess of background concentration) become visible. |
| Exceeds 10 mg/L for more than 5% of the time | International Boundary | Accepted threshold for cross border impacts based on previous studies, e.g. IDPT ¹ . |

Note: ¹PIANC Report No. 108 (2010).

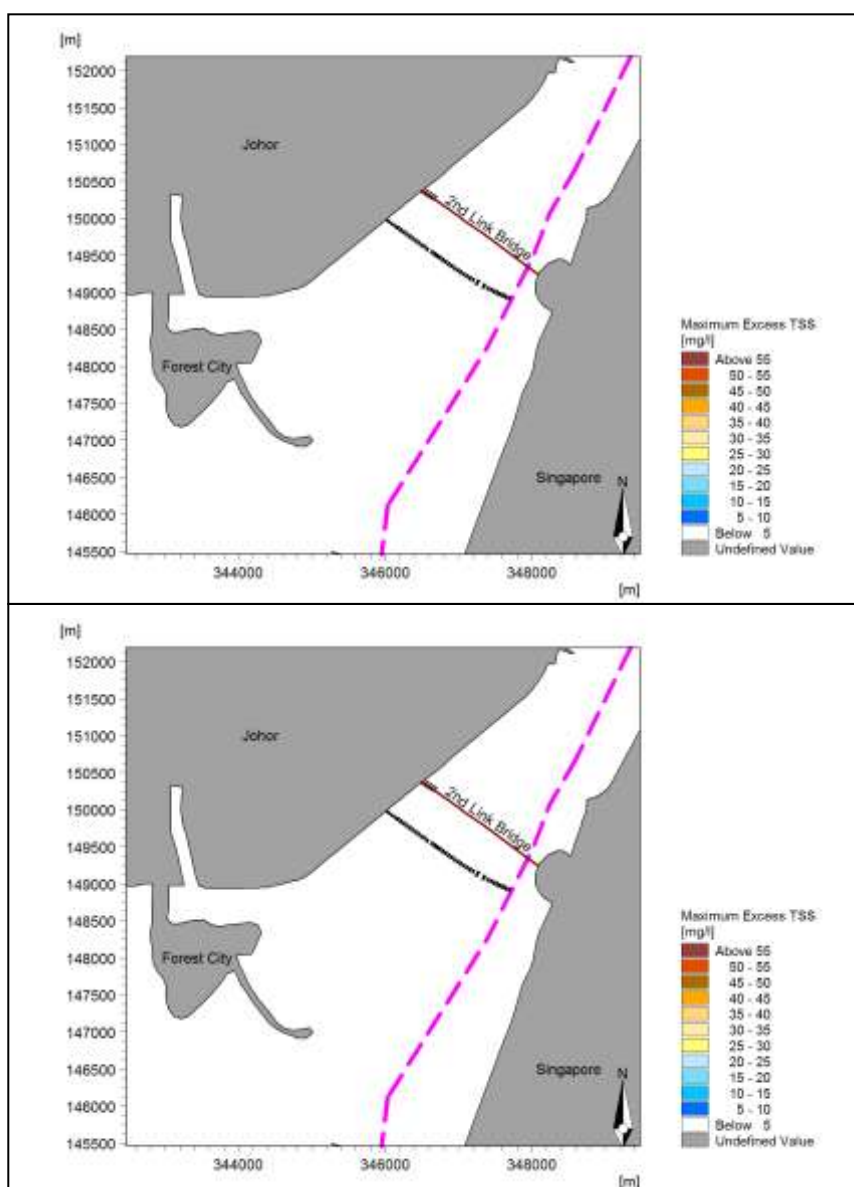


Figure 7-70: Maximum excess TSS levels for inter (top), northeast (middle) and southwest (bottom) monsoon conditions.

7.7.1.3 Construction of Elevated Structures/Bridges

Waste Discharges: Construction activities may impact the water quality within vicinity of the project site through oil spills and/or leakage from construction machinery and transportation vessels. Impact will be for a limited duration with low degree of induced adverse impacts. Impacts will be localized only within the working boundary.

Impact will be during construction phase with low degree adverse impact and localized only within the working boundary.

7.7.2 Operational Phase

The principal Project's operations related activities that are capable of inducing environmental impacts include:

1. Footprint of piers
2. Repair and maintenance work on track

The potential impacts that could occur during the Project's operational phase are assessed herewith.

7.7.2.1 Footprint of Piers

Hydrodynamic Properties: The change in the flushing conditions is evaluated based on an analysis of the changes of the tidal prism, defined as volume of water crosses a section for a tidal cycle (high tide to low tide). In order to evaluate the potential changes in the discharges across these areas, the tidal prism has been calculated for baseline and post development at transects L1 and L2 shown in **Figure 7-71**.

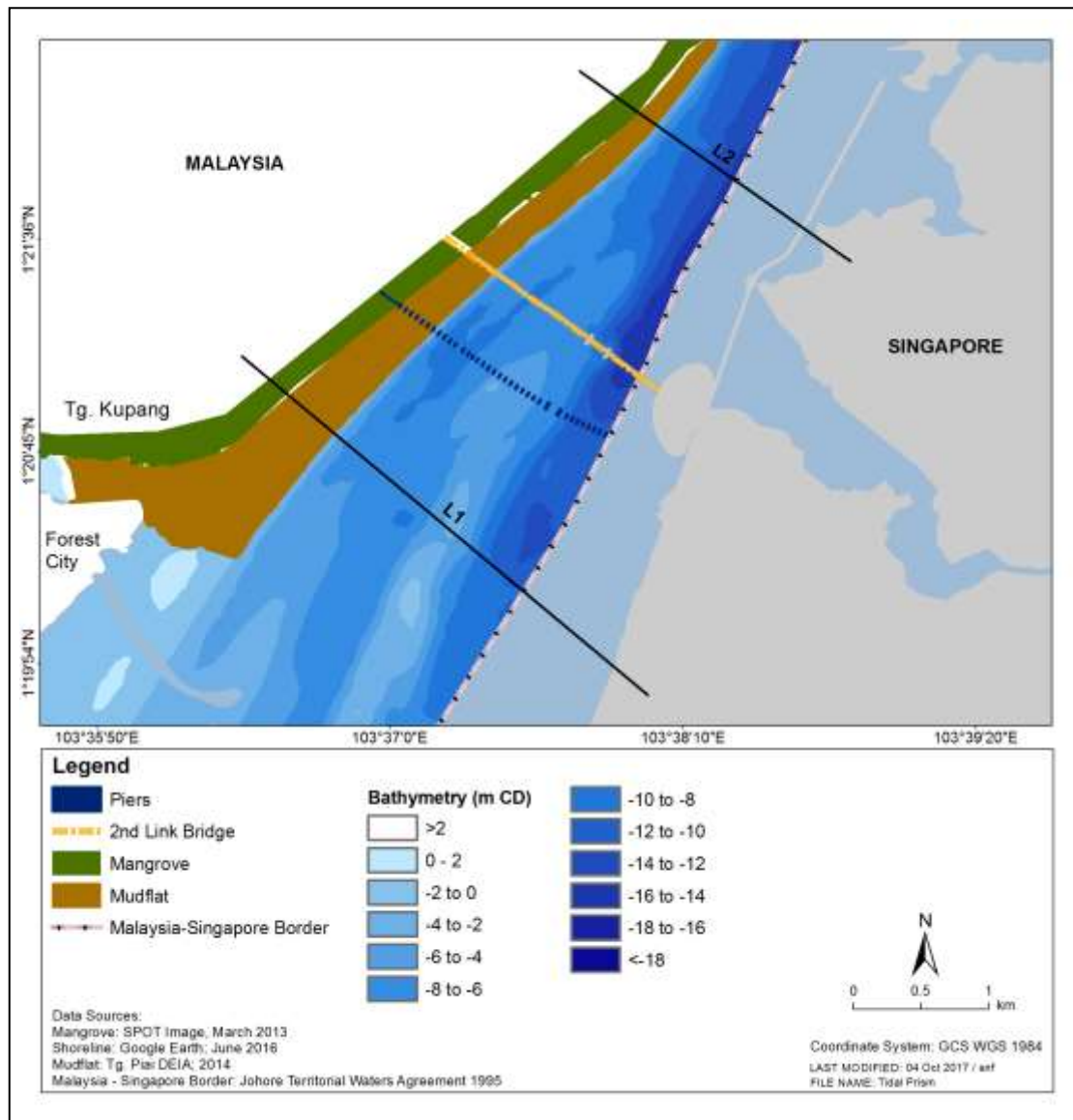


Figure 7-71: Transect line L1 and L2 for calculation of tidal prism.

The computed tidal prism results for baseline condition and post development are presented in **Table 7-39**. Based on the modelling results the following findings can be drawn:

- Insignificant changes (less than 0.1%) on the tidal prism are predicted indicating that the changes in the water exchange in the study area will be insignificant; and
- Consequent impacts on water quality and flushing conditions are insignificant and considered negligible.

Table 7-39: Predicted tidal prism based on differences in water discharge volume for a tidal cycle.

| Transect | Baseline | With HSR alignment | |
|----------|--|---|--|
| | Water Discharge volume (million m ³) | Difference water discharge volume (million m ³) | Difference of water discharge volume in percentage (%) |
| L1 | 170.900 | -0.112 | -0.066 |
| L2 | 145.994 | -0.105 | -0.072 |

Sedimentation / Erosion: The predicted sedimentation rate induced by the HSR alignment has been simulated for all three climatic conditions, and these have been combined to calculate the annual sedimentation rate as shown in **Figure 7-72**. The results indicate that changes in bed level of approximately 0.2 m per year occur in the offshore area where the current speed is stronger, but these occur locally within the vicinity of the piers and extend to the main span of second link bridge (**Figure 7-72**). It should be noted that these predictions show initial changes after the project has been constructed, whereas once the sediment transport at the study area reaches equilibrium, the sedimentation/erosion rate will reduce to zero.

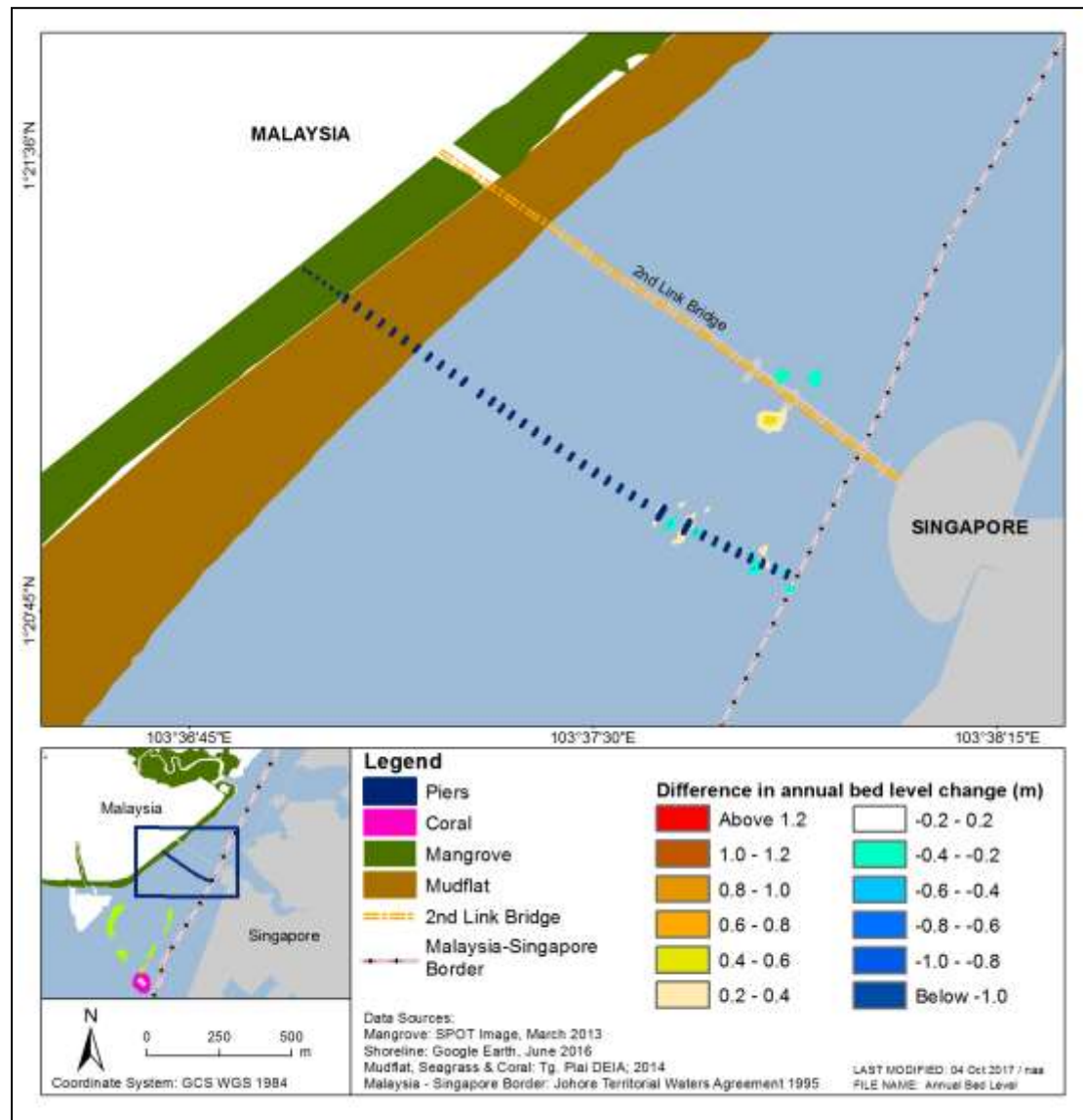


Figure 7-72: Predicted Difference in Annual Bed Level Change During Operational Phase.

Impact will be during Operational phase with low degree adverse impact and localized only within the vicinity of the project area.

Water Level: As shown in **Figure 7-73** and **7-74**, changes in maximum water level for all climatic conditions are less than 0.01 m within and around the study area, which will result in insignificant impacts.

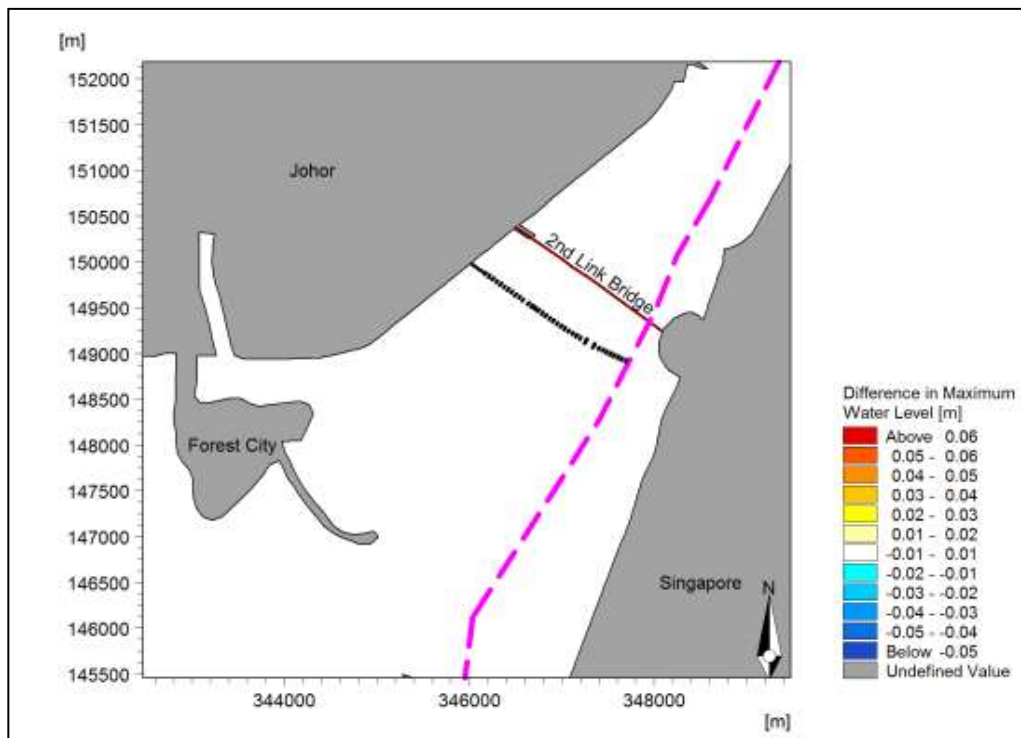


Figure 7-73: Predicted difference in maximum water levels during operational phase (Inter-monsoon).

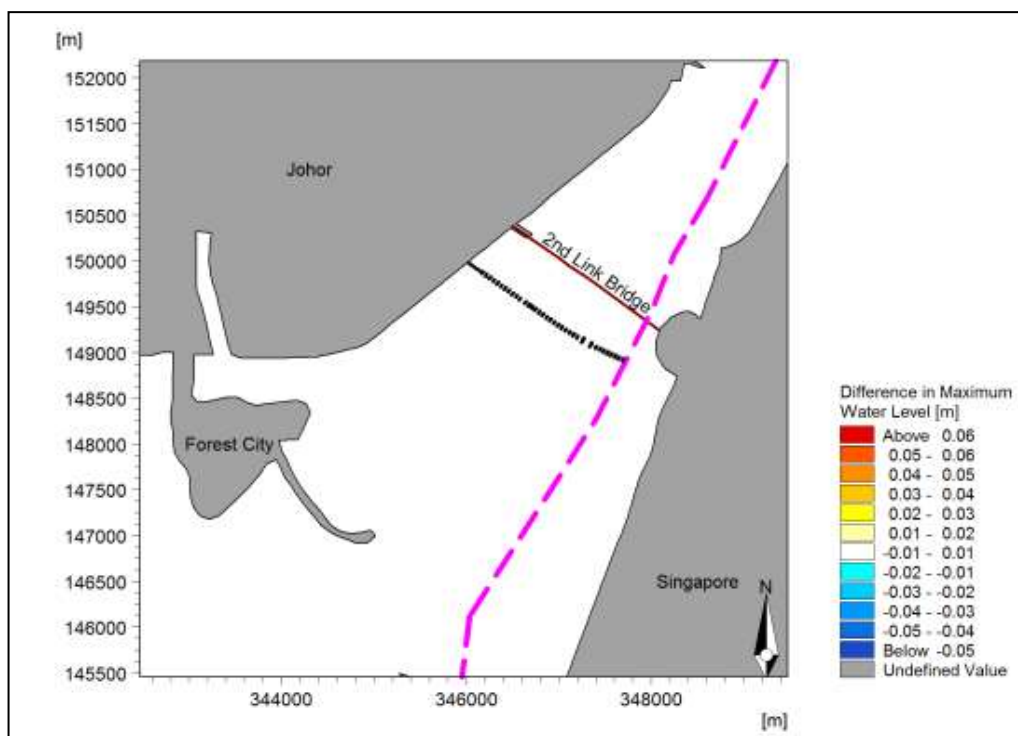


Figure 7-74: Predicted difference in maximum water levels during operational phase (Northeast monsoon).

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Current Flow: The current changes in mean and maximum current speeds during the Project's operational phase for inter-monsoon, northeast monsoon and southwest monsoon scenarios are depicted in **Figures 7-75 to 7-81**.

Predicted changes in current speeds are less than 0.04 m/s for mean current speed and 0.1 m/s for maximum current speed, particularly at the main span where there are 42 piles in place and the currents are stronger. Overall, the changes in current flow are minimal and localised (500 m from the project footprint within Malaysia boundary), with no cross-border impact predicted.

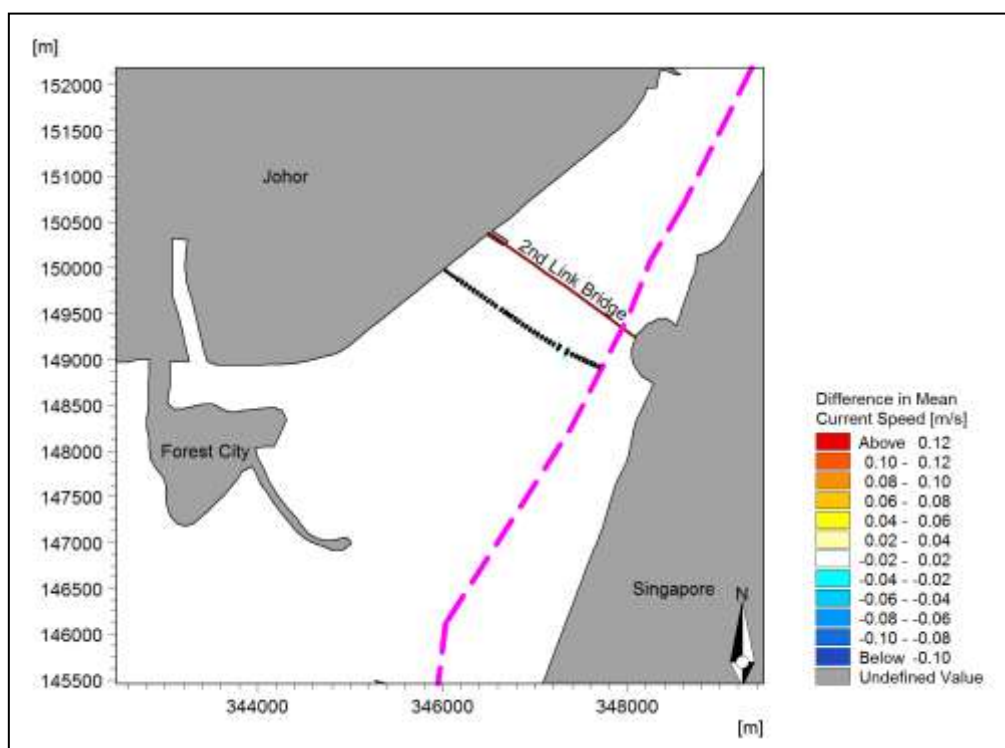


Figure 7-75: Predicted difference in mean current speed during operational phase (Inter-monsoon).

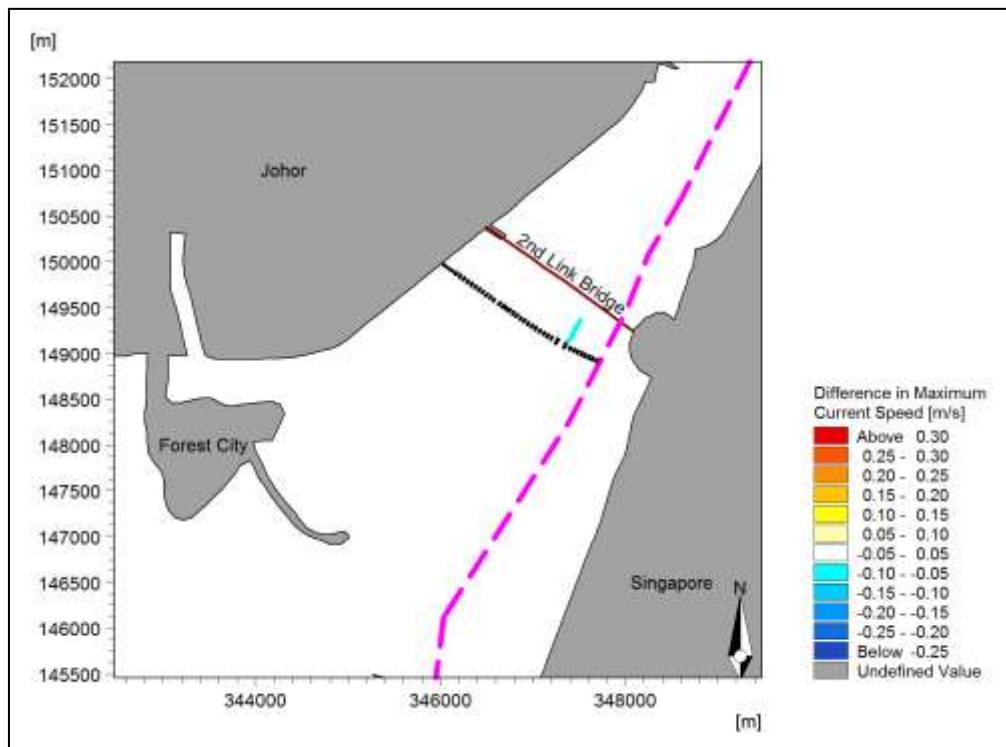


Figure 7-76: Predicted difference in maximum current speed during operational phase (Inter-monsoon).

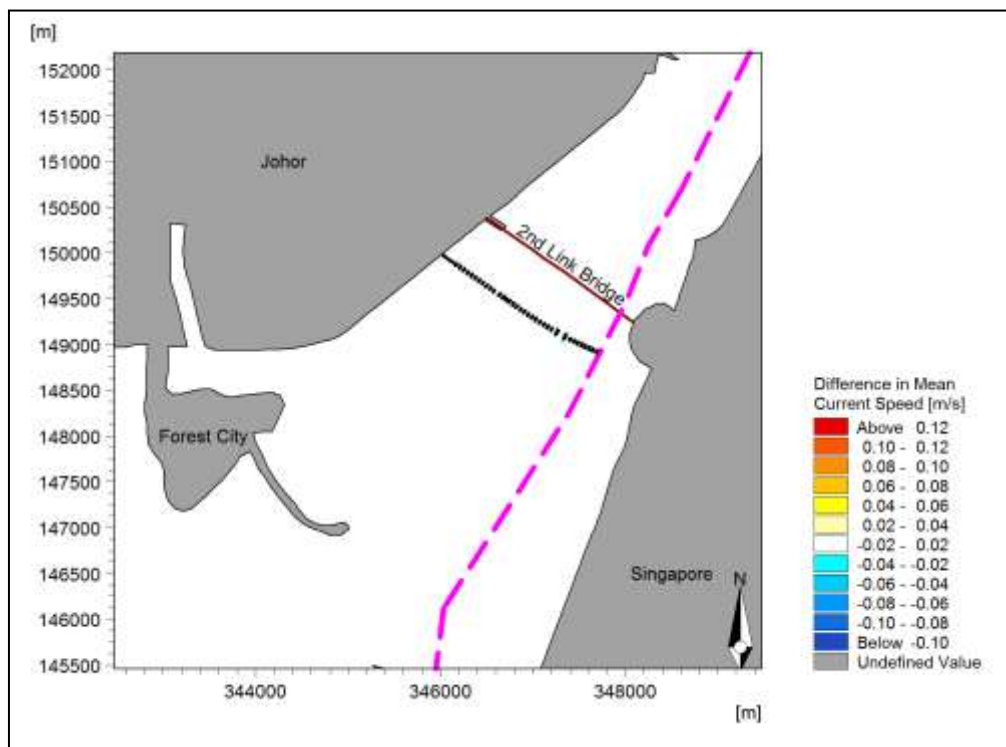


Figure 7-77: Predicted difference in mean current speed during operational phase (Northeast monsoon).

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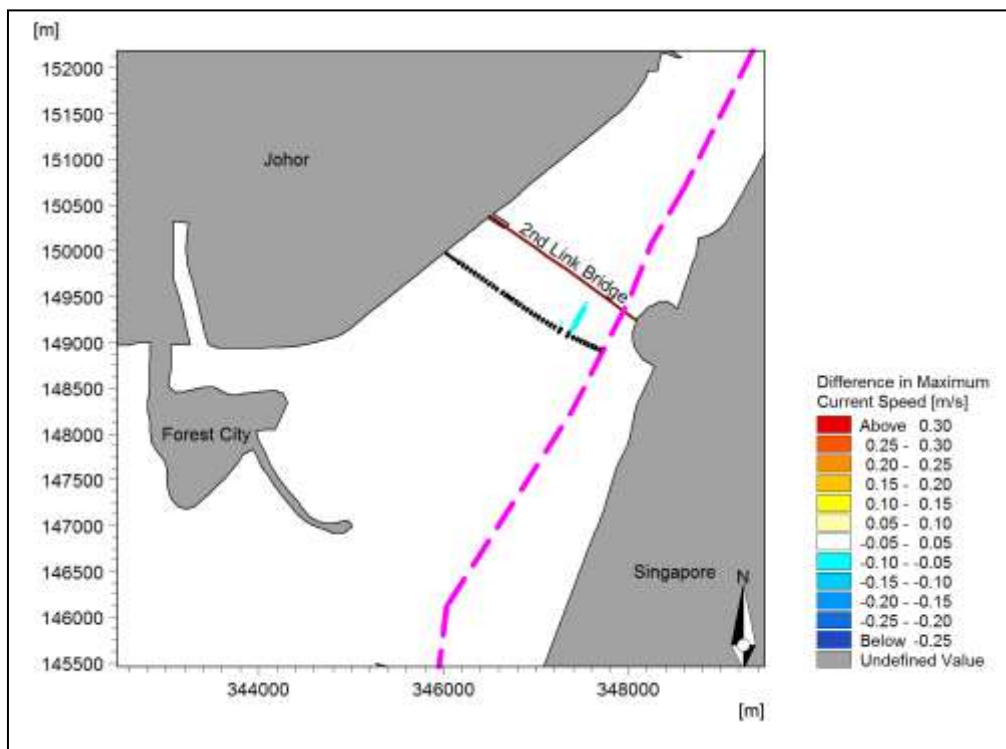


Figure 7-78: Predicted difference in maximum current speed during operational phase (Northeast monsoon).

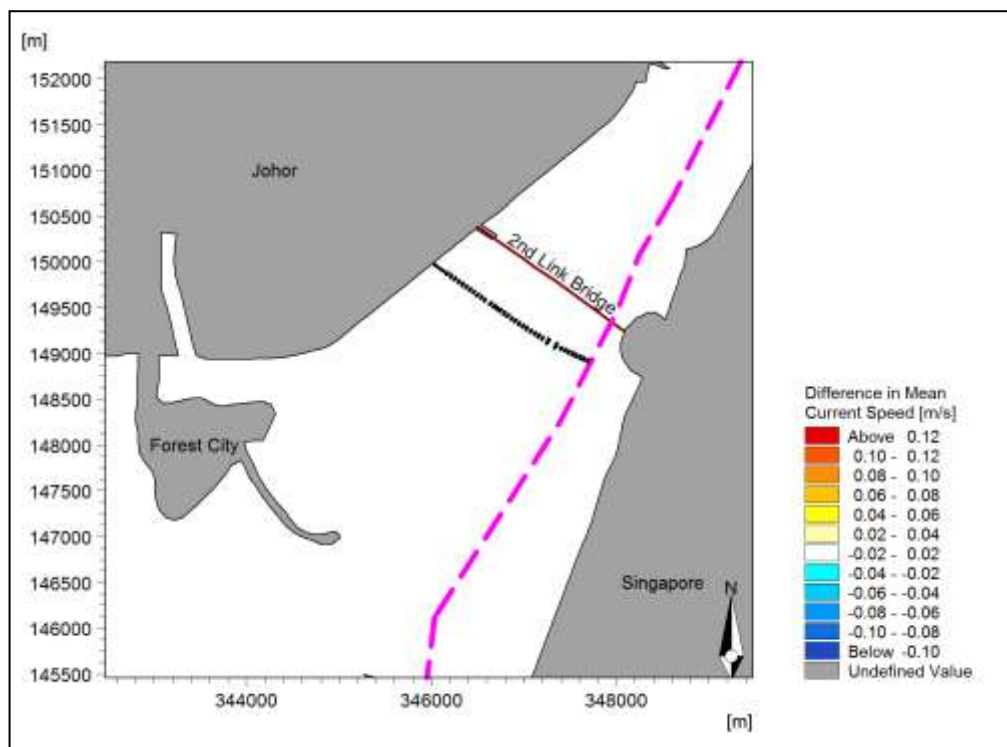


Figure 7-79: Predicted difference in mean current speed during operational phase (Southwest monsoon).

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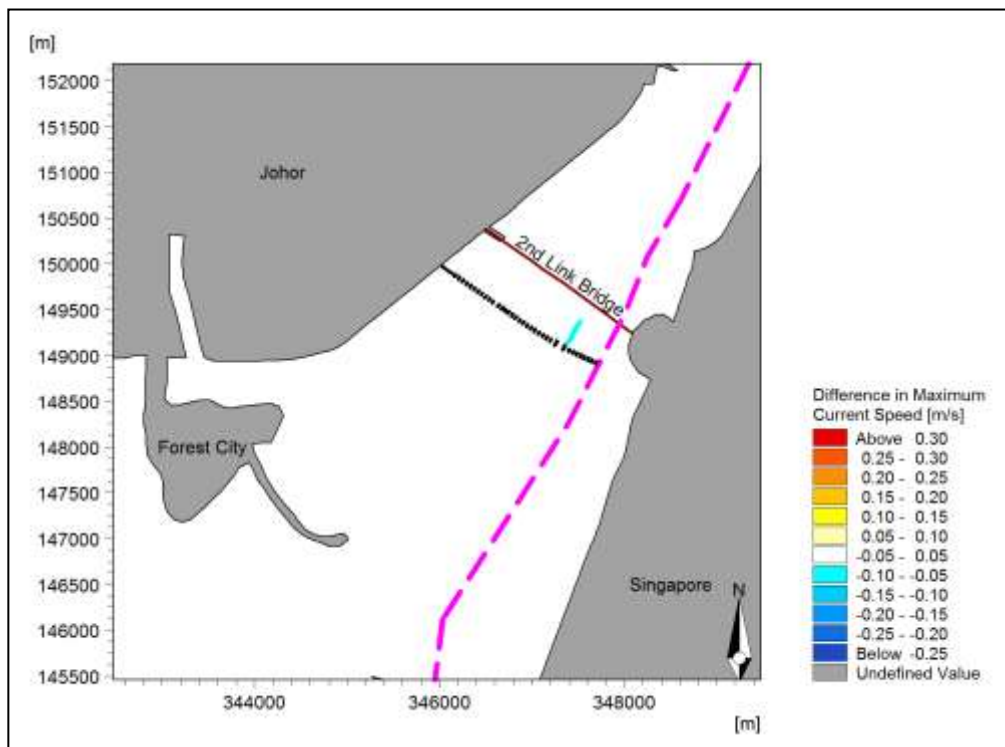


Figure 7-80: Predicted difference in maximum current speed during operational phase Southwest monsoon).

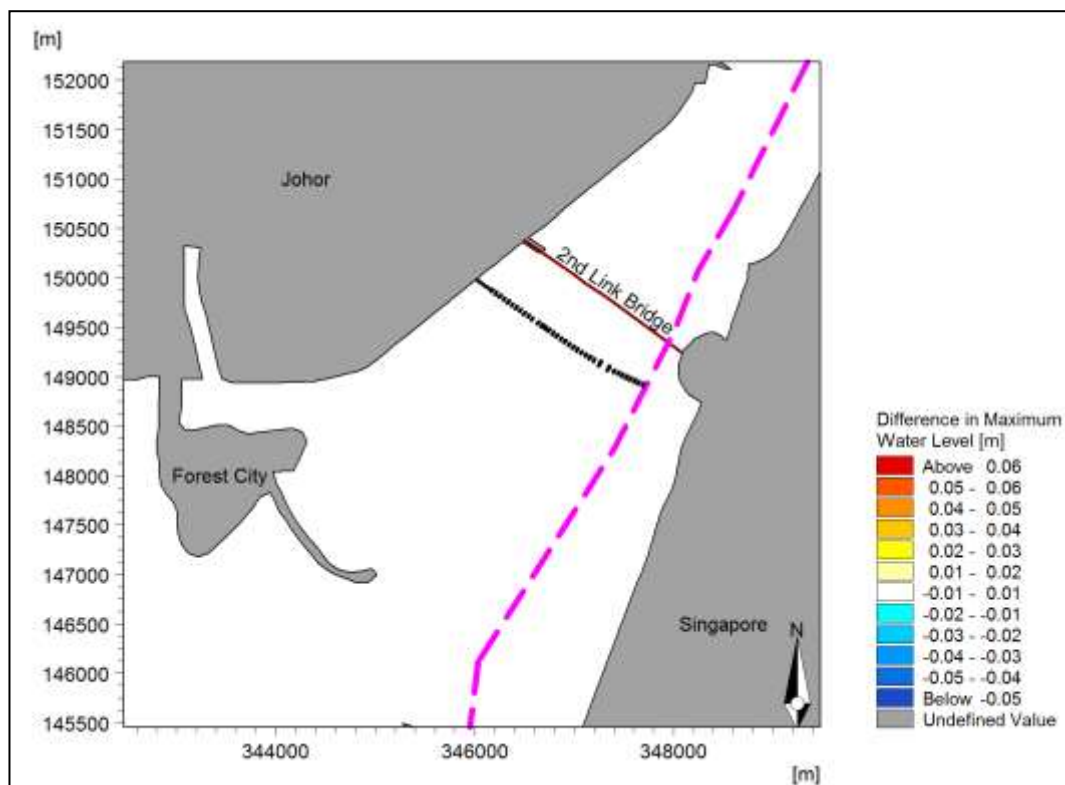


Figure 7-81: Predicted difference in maximum water levels during operational phase (Southwest monsoon)

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Wave Height: The proposed development is located at a sheltered channel where the wind-wave fetches are short thus the waves in this area are weak. Changes in mean and maximum wave heights during the Project's operational phase for all climatic conditions is depicted in **Figures 7-82 to 7-87**.

During the northeast monsoon, a reduction in significant wave height occurs southwest of the project which is related to the predominant north-easterly wind. Overall, the changes in wave are minimal and localised (500 m from the project footprint within Malaysia boundary) which is highly unlikely to cause any impacts to other areas or cross-border impact.

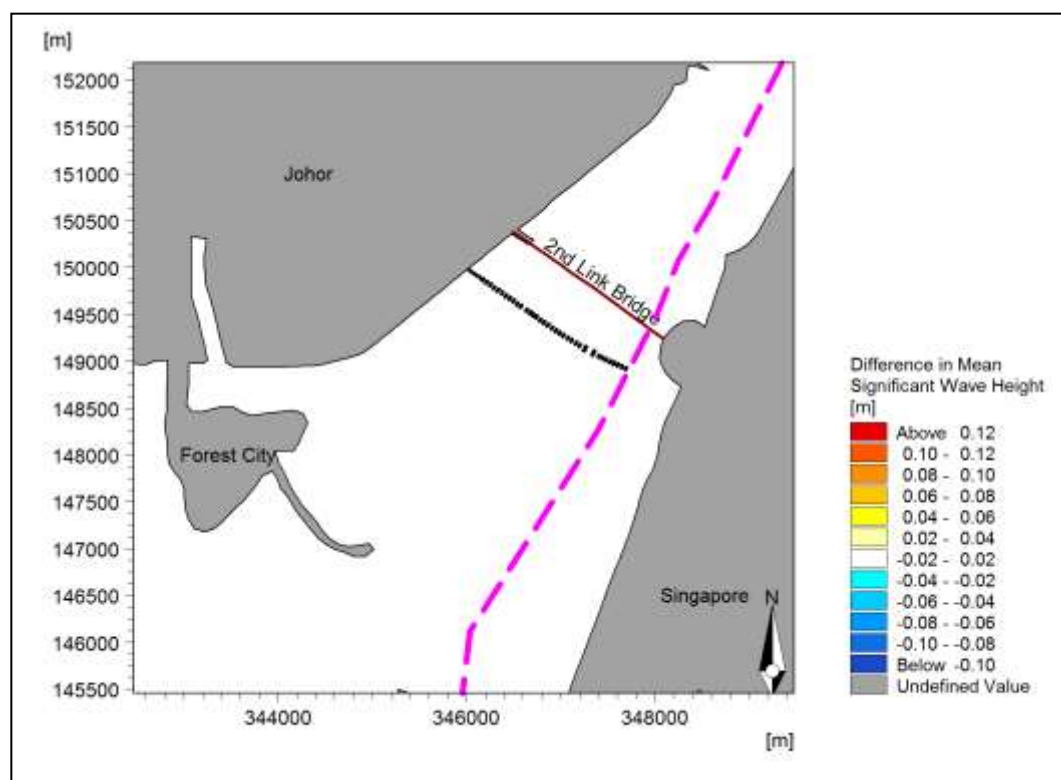


Figure 7-82: Predicted difference in mean significant wave height during operational phase (inter-monsoon).

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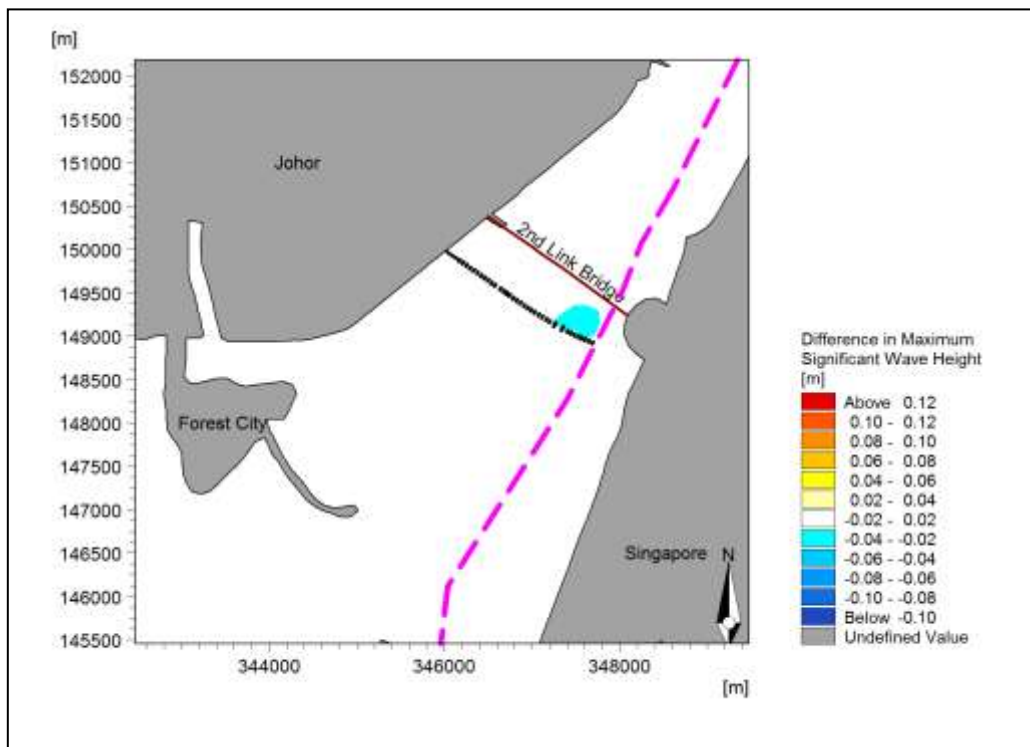


Figure 7-83: Predicted difference in maximum significant wave height during operational phase (inter-monsoon).

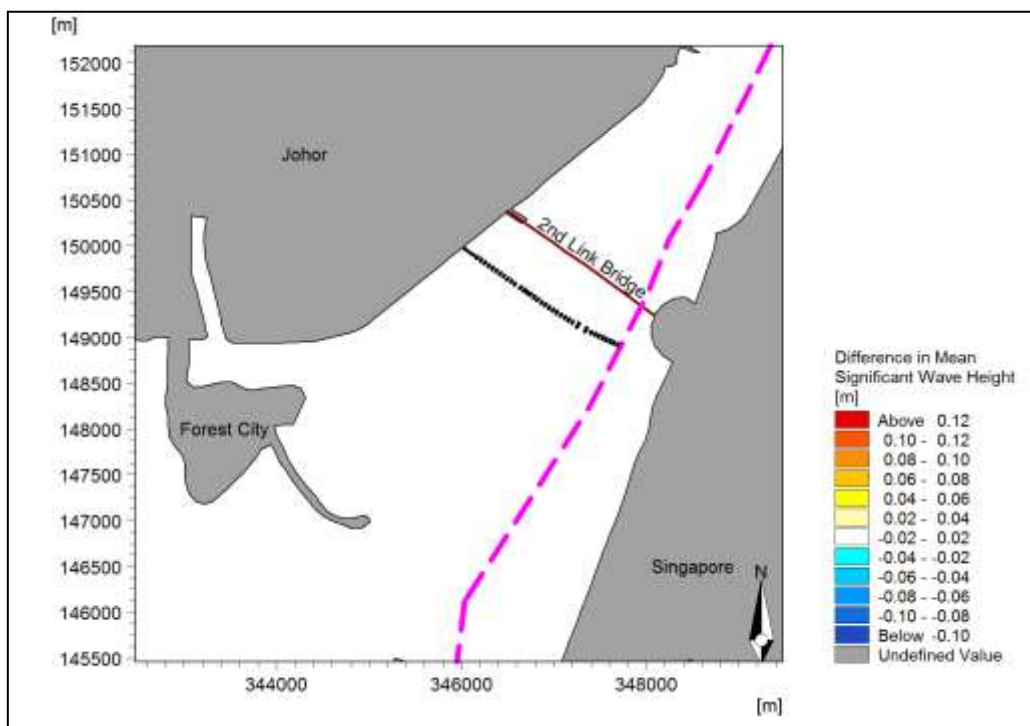


Figure 7-84: Predicted difference in mean significant wave height during operational phase (Northeast monsoon).

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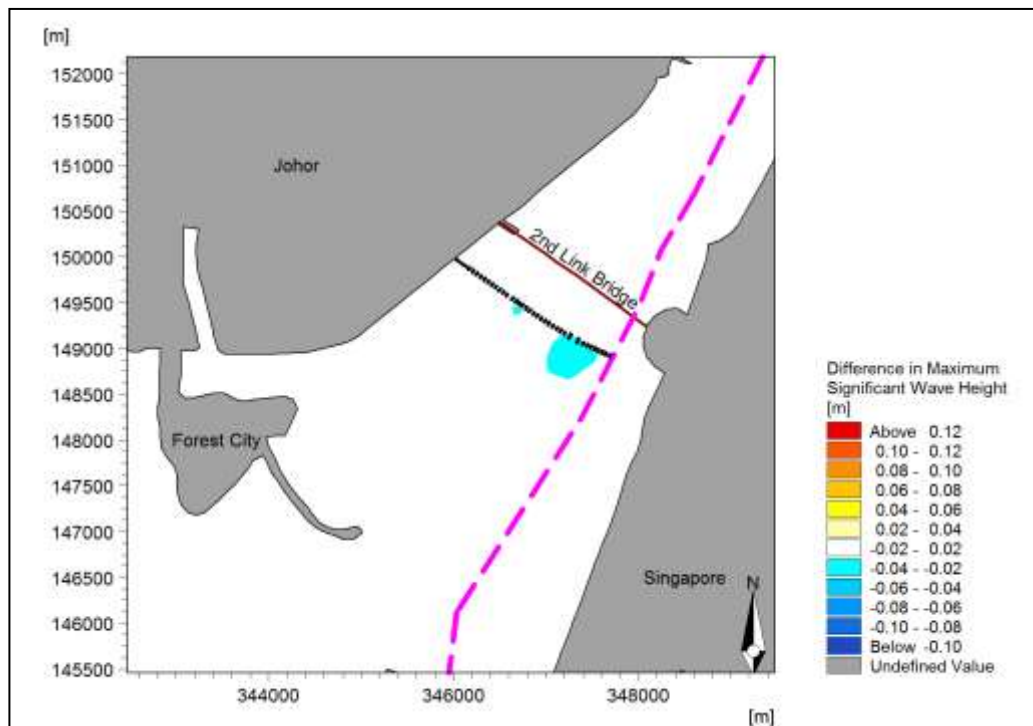


Figure 7-85: Predicted difference in maximum significant wave height during operational phase (Northeast monsoon).

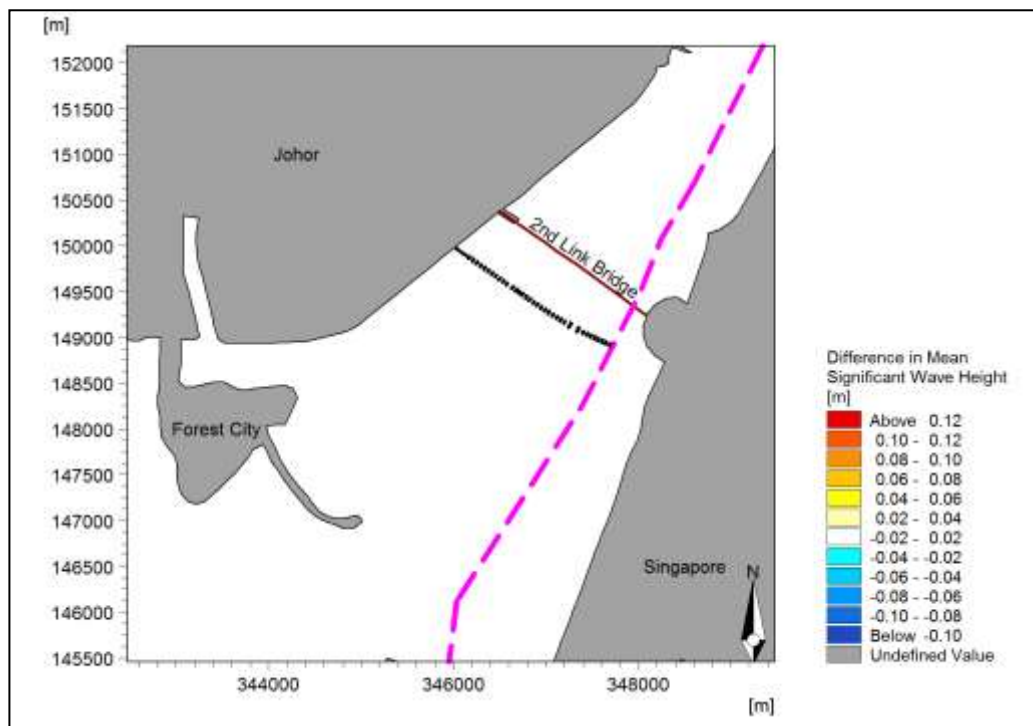


Figure 7-86: Predicted difference in mean significant wave height during operational phase (Southwest monsoon).

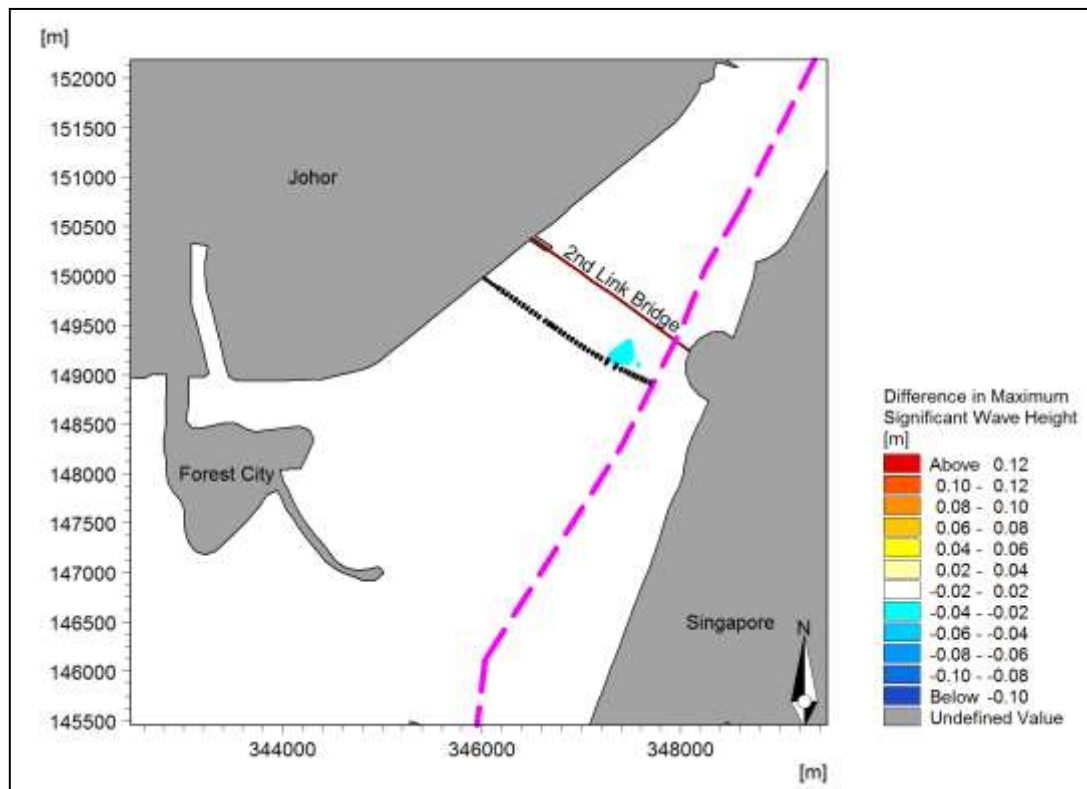


Figure 7-87: Predicted difference of maximum significant wave height during operational phase (Southwest monsoon)

7.7.3 Cumulative Impact Assessment

Johor is experiencing a rapid growth and it is crucial to account for the combined effect of all planned developments to ensure the Johor straits environment is not impacted negatively. In order to evaluate the potential cumulative impacts, surrounding approved developments were provided by JPS (**Appendix 7G**). For this assessment, approved projects listed below and shown in **Figure 7-88** are taken into account to assess the cumulative impact.

- J55 – Phase III dredging and reclamation work at Pelabuhan Tg Pelepas.
- J59 – ATT Tg Bin jetty extension
- J60 – Reclamation Tg Piai
- J63 – Puteri Harbour
- J73 – Johor lagoon park
- J74 – Lido waterfront boulevard
- J75 – Forest City mixed development
- J77 – Bridge crossing Sg. Pulai

At the present stage, detailed information on these approved projects are unknown. Thus, the assessment will focus only on impacts on current speeds.

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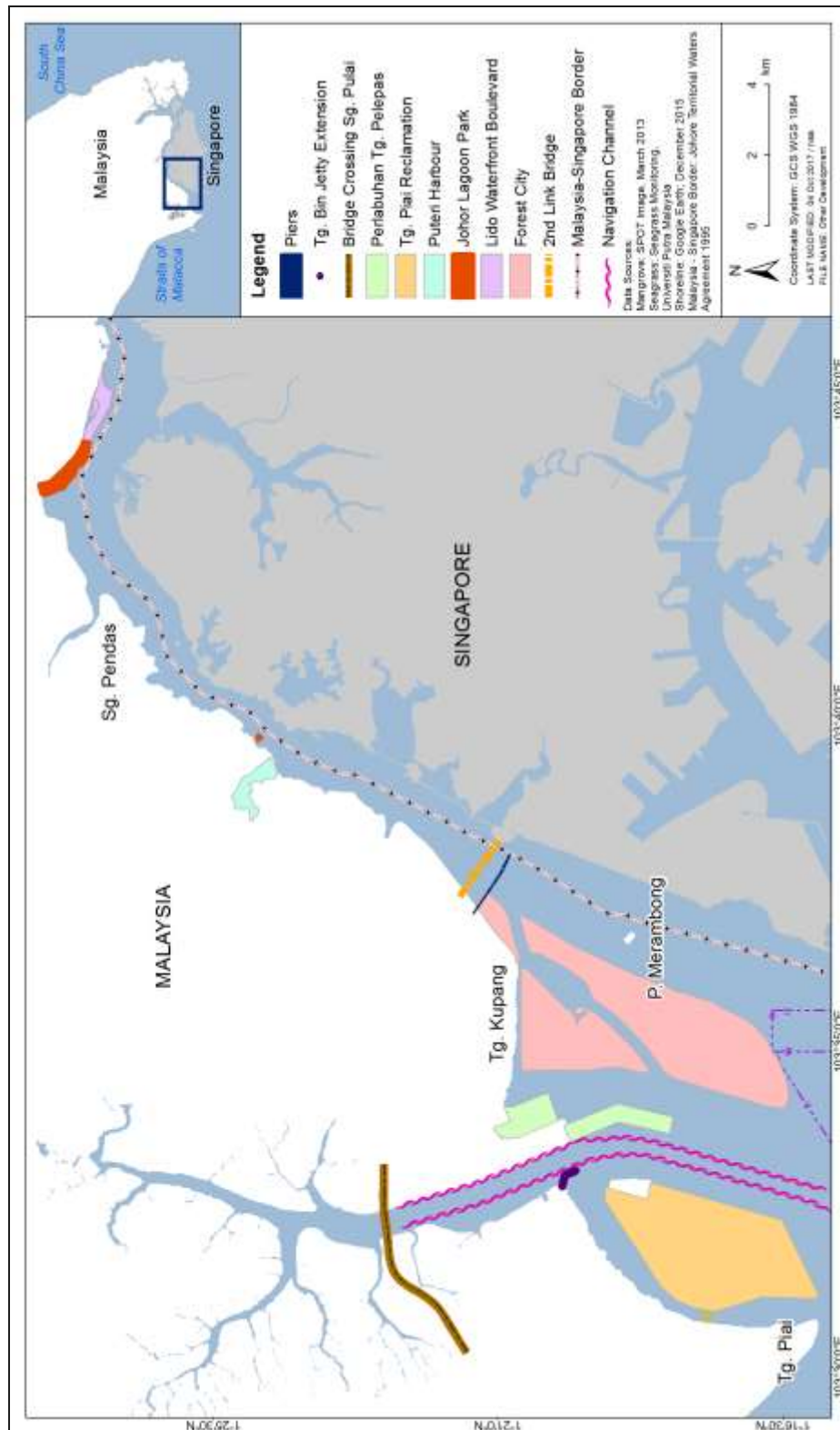


Figure 7-88: Projects considered in the cumulative impact assessment

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In order to evaluate the potential cumulative impacts of the approved future developments, an assessment of impact of these projects against the baseline (existing conditions) has been carried out with and without the HSR Project. **Figure 7-89** and **Figure 7-90** present the predicted differences in mean and maximum current speed respectively. Based on analysis, the findings are summarised below:

- Minor changes are predicted for the case with and without the HSR alignment indicating that the contribution of the HSR alignment on the cumulative impacts is minimal and localised around the piers and insignificant in vicinity areas.

Large developments southwest of HSR alignment for instance Tanjung Pelepas, Tanjung Piai, Tanjung Bin, Forest City and Sungai Pulai alter the current flow at the area, where changes in current speeds up to 0.5 m/s can be observed around the proposed reclamation area. Increase in currents is noticed in the channels whereas reduction is observed next to the reclamations, however no significant impacts are predicted beyond the international border

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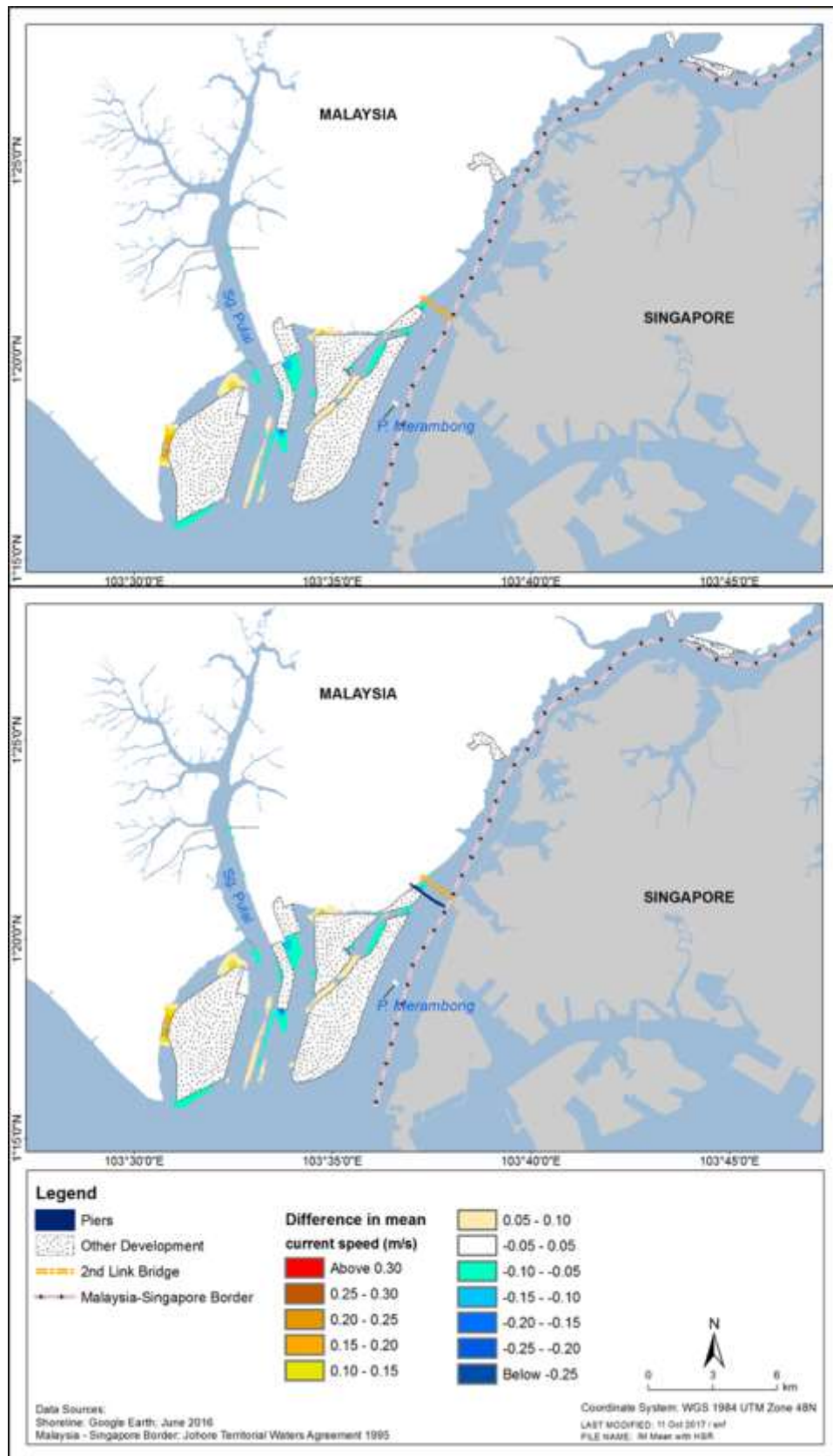


Figure 7-89: Predicted differences in mean current speed for cumulative layout compared to baseline.
Without HSR alignment (top) and with HSR alignment (bottom)

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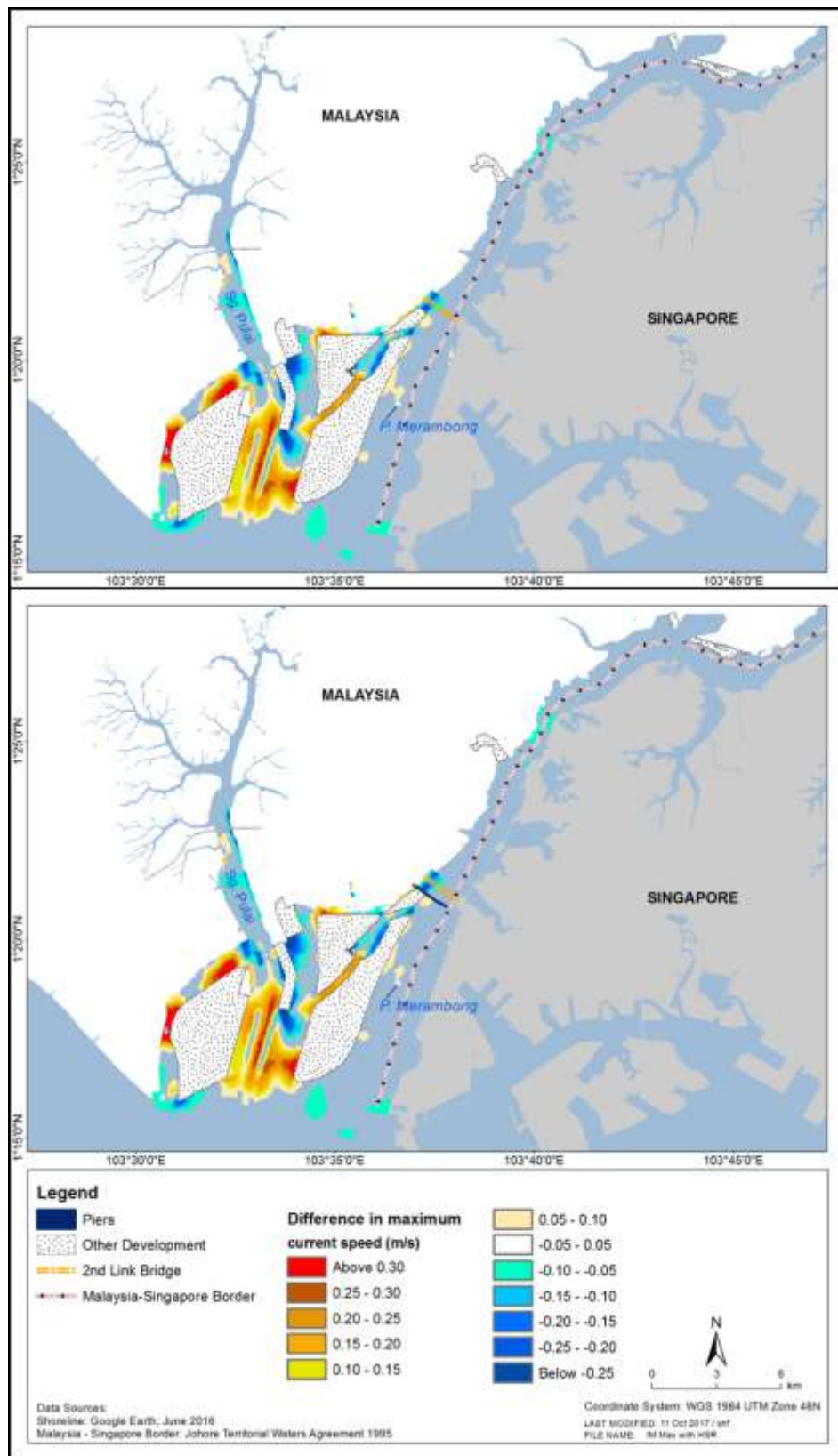


Figure 7-90: Predicted differences in maximum current speed for cumulative layout compared to baseline. Without HSR alignment (top) and with HSR alignment (bottom)

7.8 GEOLOGY AND HYDROGEOLOGY

The construction of HSR alignment involves major civil engineering works such as the construction of Bridges, Elevated Structures, shallow and deep foundations, excavations works, retaining walls, cut and fill slopes, and tunnelling works. Issues and problems related to the impact of geology and geotechnical to the engineering works and also the impact of the structure to the geology (geotechnics) shall be highlighted to minimise impacts to the surrounding environment and therefore reduce the risk of structural failures.

Most of civil engineering structures in HSR Project may affect the stability of the soil and rock masses in various ways such as; (i) changes made to the ground topography by earthworks including cutting, filling and/or excavation; (ii) changes in natural drainage system; and (iii) changes in vegetation on site.

The key parameters in determining the structure type to be used lies in the topography of the land. The type of structures proposed for the HSR Project is At-Grade, Elevated, Tunnel, grade separation and river bridge. Elevated Structure is a dominant engineering design for HSR Project. There are several stretches with At-Grade rail track. Seven (7) tunnels will be constructed along the HSR alignment, one (1) located in Kuala Lumpur till Selangor (8.8 km), two (2) in Selangor (0.7 km and 2.3 km), two (2) in Negeri Sembilan (each 0.4 km) and two (2) in Johor (1.9 km and 0.4 km).

7.8.1 Geology

7.8.1.1 Pre-Construction Phase

7.8.1.1.1 Detailed site investigation

Subsurface information and geotechnical data are required for the planning, development and design stages of all construction projects particularly for ground improvement and foundation design. A comprehensive site investigation (SI) is required for detailed design of the HSR alignment. The Project Delivery Partner (PDP) shall undertake his own additional soil investigation and material surveys for the purpose of preparation of the detailed

engineering design and construction of the works. A copy of the geotechnical report shall be submitted to Mineral and Geoscience Department.

7.8.1.2 Construction Phase

A) FT. Kuala Lumpur

The geology of FT. Kuala Lumpur is consisting of mainly of granite, limestone and meta-sediment which can be classified as strong foundation for most of the structures. The construction of HSR alignment in FT. Kuala Lumpur will involve the Elevated Structures and Tunnel.

- (i) The environmental impact of Elevated Structures is due to differential settlement due to unsuitable foundation of elevated piers. A thick layer of residual soil may increase the cost of piling claim to reach the sound rock which is located at greater depth. Foundation in karstic limestone area must be given extra safety measures to avoid putting the pile foundation on a limestone pinnacles or above the underground cavern. Kuala Lumpur Limestone has karstic features due to the highly soluble nature of the limestone, the tropical weather has produced deep weathering with the less soluble dolomitic rock forming the tower-like pinnacles. In addition, solution cavities Kuala Lumpur limestone area was also heavily mined in the past leaving behind numerous ponds and remnants consisting of sand and clay slime, forming a highly heterogeneous overburden of limestone (**Figure 7-91**)

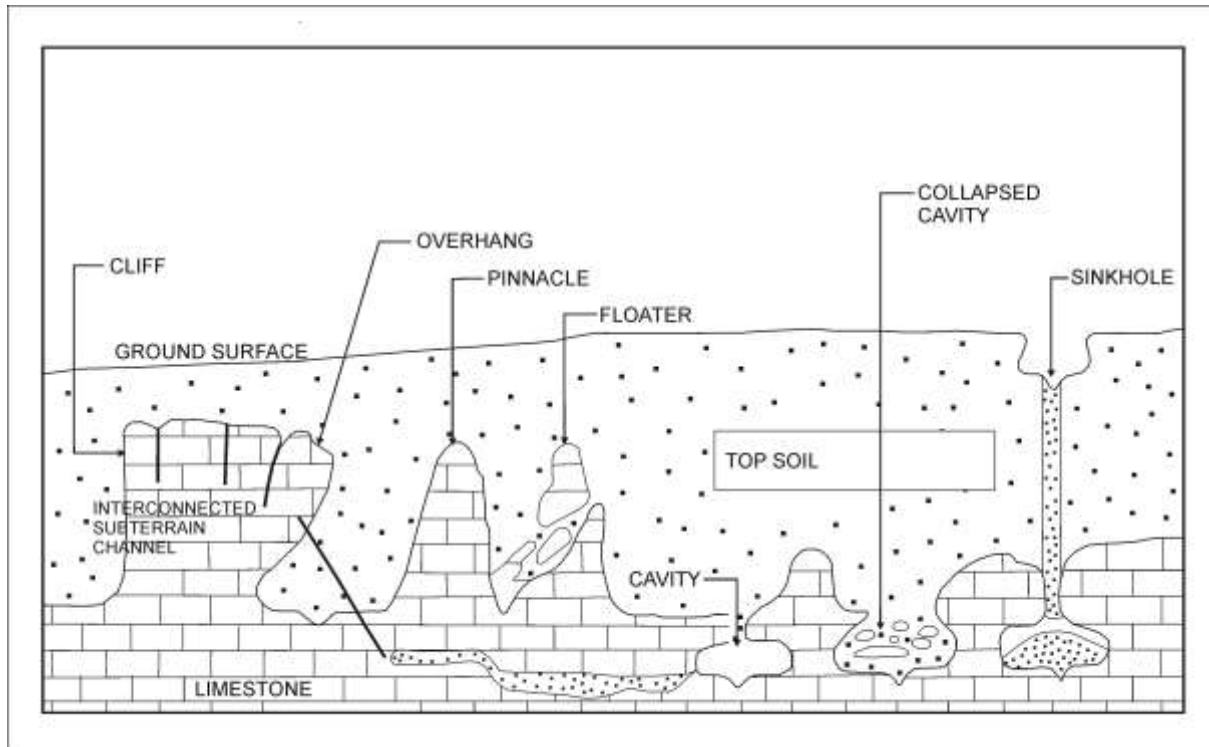


Figure 7-91: Karstic features of limestone

- (ii) The underground portion (**Tunnel**) will start with a North Portal located at Kg. Baru Salak Selatan and will continue underground crossing Terminal Bersepadu Selatan (TBS) at Sg. Besi. The HSR alignment will go under the existing KTM and ERL track. The HSR alignment exiting FT. Kuala Lumpur and entering Selangor will be underground. The length of Tunnel in Kuala Lumpur area is 5.0 km. The methods of excavation could be by TBM or mechanical excavation depending on the geotechnical characteristics of the ground and the lengths to be excavated. The tunnel will be constructed mainly in Kuala Lumpur Limestone and/or along the contact between the Kuala Lumpur Limestone and granite (**Figure 7-92**). Most the Kuala Lumpur Limestone has karstic features that may greatly decrease the quality of rock mass and reduce the stability during Tunnel construction. There is also a possibility of fault contact between Batu Kapur Limestone and granite that may greatly influence the construction of the tunnel, especially due to highly fractured zone and highly permeable rock mass that may contain large amount of groundwater. According to Mohammad Ayob (1970), the contact between the limestone and the granite was never been seen but it is probably a fault, striking approximately north-south. The problems of Tunnel stability (collapsing) and

groundwater seepage into the tunnel are expected while excavating through this formation.

- (iii) Weak zones such as highly fractured rocks, shear zones, or fault lines are challenging in tunnel construction. Weak zone can cause instability to the tunnel roof hence led to collapse and overbreak of the tunnel perimeter. The HSR alignment will cut across the possible fault line as shown in **Figure 7-92**. Fault zone is geologically weak zone in which construction of major civil works on top will require proper treatment on the foundation.
- (iv) There is a potential environmental issue with the soil deposits in Kuala Lumpur area consist of alluvial deposits, mine tailings, manmade fills, organic mud and peat, and residual soils of the various rock formations. The main concerns are the soft soils such as mining slimes, municipal wastes and the very weak collapsed zone above the limestone bedrock.

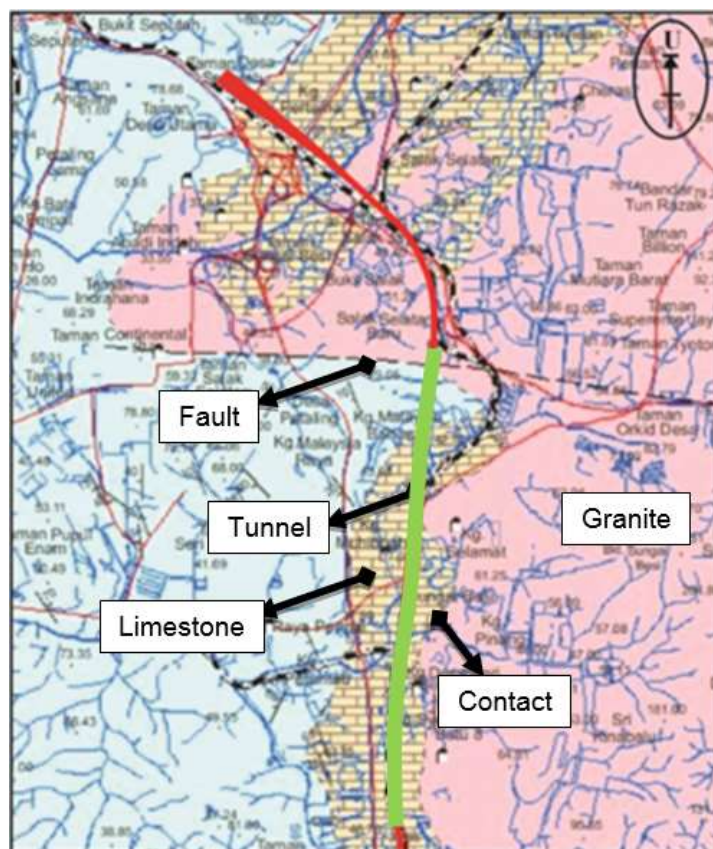


Figure 7-92: The tunnel route along the HSR alignment will be constructed mainly in karstic Kuala Lumpur Limestone (JMG, 2010)

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- (v) The impacts to groundwater regime during the construction of the tunnel. Groundwater is always a main concern for deep excavation works to reduce the rate of groundwater inflow into the excavation tunnel. It is a way to reduce pathways of water flow into the excavated area in order to prevent excessive groundwater drawdown.
- (vi) Tunnel excavation will produce a lot of excavated material (i.e. waste rock) also known as muck. Huge amount of tunnel muck, which, if not re-used, has to be dumped, with high costs concerning both the impact on the territory and the Project itself. In tunneling excavation, two very important aspects have to be taken into account: the dumping of the excavated material and the opening of new quarries to supply raw materials. A solution that could be proposed to minimize these relevant environmental problems is the recycling, or reusing, of the muck from tunnel excavations which can be employed as aggregates for concrete.



Figure 7-93: The tunnel excavation in Kuala Lumpur will be constructed laterally at lower surface topography (Elevation 50 m).

B) Selangor

- (i) The structure of HSR alignment in Selangor is mainly Elevated Structure and At-Grade Structure. The geology in Selangor area is not similar with Kuala Lumpur area, where it is only comprised of residual soil from meta-sedimentary rocks. Residual soil from meta-

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sedimentary rocks is a good material for the foundation of HSR alignment. The piers of elevated structure can be founded on the bedrock of meta-sedimentary rock.

(ii) Construction materials

The foundation of HSR alignment using At-Grade Structure will require large amount of construction materials. By looking at the geological map of Selangor, one can easily identify that Selangor has abundance of granites especially at the east part. However, the location of granite as potential construction material is located quite at a distance from the HSR alignment. The haulage of aggregate materials from the nearest granite quarry will increase the number of lorries on the road and will also increase the construction cost for this Project.

- (iii) There is one (1) tunnel will be constructed near Bukit Unggul Golf and Country Club in Selangor. The length of the tunnel is about 2.3 km. This Tunnel will be constructed in a metamorphic rock formation comprising of phyllite, quartzite and slate. The drilling method for this tunnel could probably be mechanical excavation but depending on the geotechnical characteristics of the ground, the depth of the tunnel and lengths to be excavated. For urban and shallow tunnels which is located in FT. Kuala Lumpur - Selangor, TBM excavation is proposed as the most suitable to prevent the settlements in the buildings and other infrastructures, like train lines, bridges and water / gas collectors. Some parts will be constructed with cut and cover method and other tunnel will be using drill and blast (NATM) method. Project Proponent shall refer to the Mining and Quarry unit from Mineral and Geoscience Department if blasting method is used for the tunnelling construction.

Geotechnical issue excavating in metamorphic rocks is due to its foliation planes (plane of weaknesses). Foliated rocks possess prominent directional properties. The strength is much weaker in the direction of the foliation than in other directions. Care should be taken that loads (bridges, dams, and buildings) are not transferred to foliated directions. In Tunnel construction, foliated metamorphic rocks are generally more costly because of more steel supports. In other meta-sedimentary rock types such as quartzite (sandstone) and interbedded of quartzite and slate (sandstone and shale), the engineering behaviour of these rock types are different, where quartzite is stronger and brittle while slate (shale) is softer and ductile. The interbedded of quartzite and slate (shale) behave differently to the excavation technique being employed in the construction of the Tunnel. For example, drill

and blast excavation method faces challenges with layered quartzite and shale because different materials behave differently to this excavation technique. Highly dense rock distributes the blasting energy better to the surrounding rock while softer rocks such as shale / slate can react as a damper (i.e. they absorb more energy from the explosive material). Weak layers of rocks on top of the tunnel roof may cause blocks to fall. It is even worse if the excavation is in the same direction as the dip of the meta-sedimentary bedding.

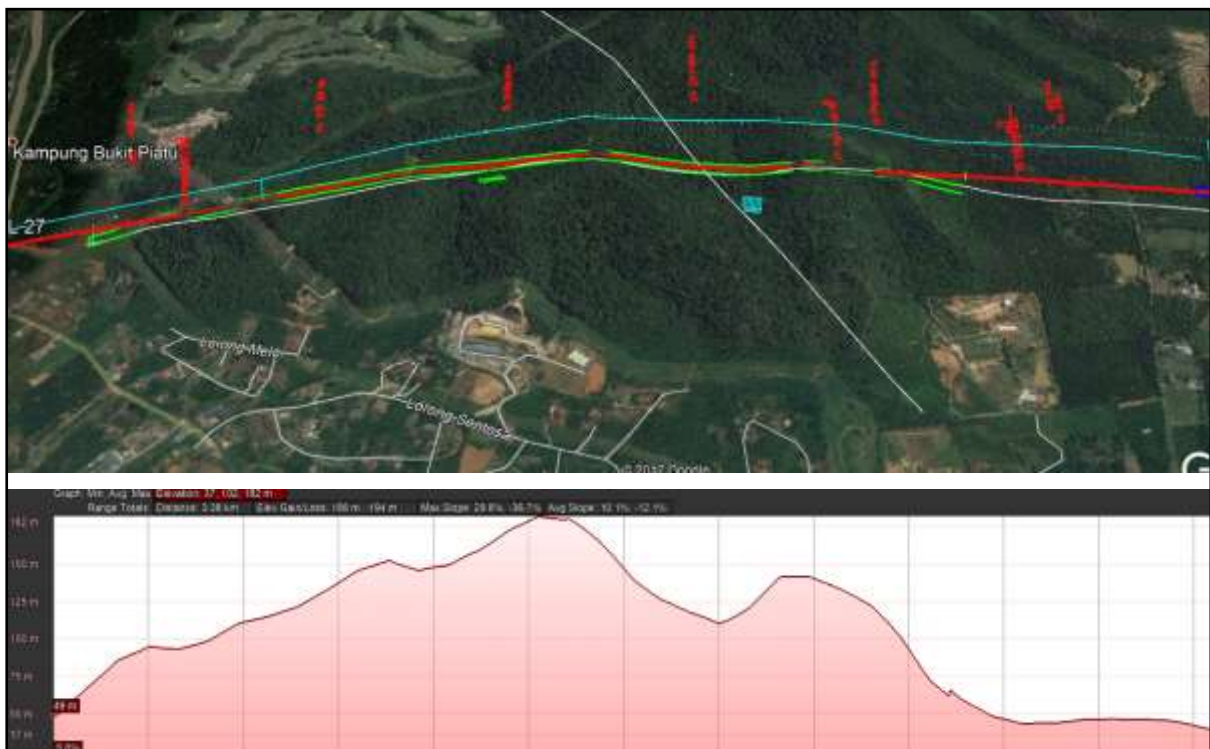


Figure 7-94: A second tunnel in Selangor with a length of 2.3 km cutting hill at the highest magnitude of 182 m

C) FT. Putrajaya

The site is underlain with meta-sedimentary rocks from Hawthornden Schist formation. The residual soil is clayey silt which is a competent cohesive soil, with adequate bearing capacity to support the embankment. It is envisaged that no special foundation treatment is required for such conditions, except replacement / recompaction of the sub-grade. Relict structures of schist can still be clearly observed in Putrajaya (i.e. as foliation planes). These planes are considered as the weakest parts of this material due to the HSR alignment of platy minerals after metamorphism. These planes are prone for sliding and failure.

The geology of FT. Putrajaya is also made of graphitic schist. Graphitic material in soils has given so many problems to engineering design. This material may contain pyrite minerals that react with water and oxygen to produce sulfuric acid in water. Acidic water corrodes the concrete and steel in foundation structure. Other problem with graphitic material is in slope design. A slope cut through this material is difficult to protect / remediate using plants / vegetation cover, i.e. plants are difficult to grow on this type of material due to its acidic nature.

D) Negeri Sembilan

For the HSR alignment in Negeri Sembilan, the HSR structure type will be intermittent between At-Grade, Elevated, Tunnel and Bridge depending on geographical conditions, development and population of the area. Tunnel will be constructed in metamorphic rocks such as schist, phyllite, and slate. Special precaution in constructing the tunnel in metamorphic rock is due to its foliation. The proposed short tunnel probably will utilise drill NATM technique as the most likely method to be used in the construction. Tunnelling in phyllite and schist may also encounter extremely strong metamorphosed rock such as quartzite. This extremely hard rock may slow down the excavation work. Two tunnels will be constructed in Negeri Sembilan with the length of 0.4 km and 0.4 km respectively. These tunnels will penetrate two hills with an elevation of 101 m and 110 m.

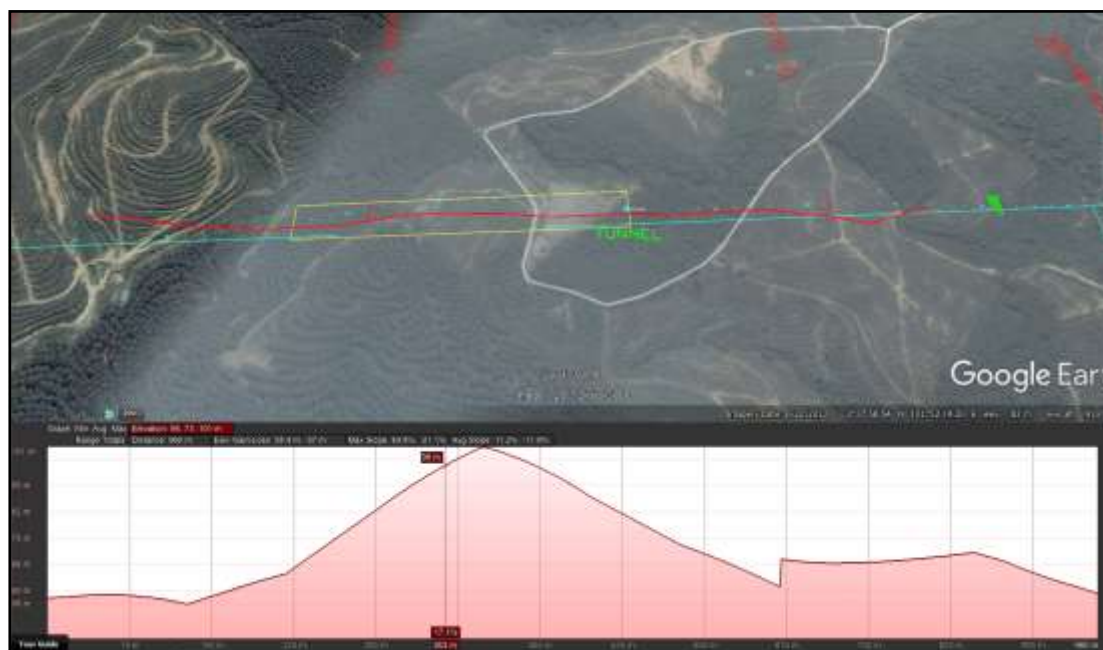


Figure 7-95: First tunnel in Negeri Sembilan with a length of 0.4 km and elevation 101 m



Figure 7-96: Second tunnel in Negeri Sembilan with a length of 0.4 km and elevation 110 m

E) Melaka

The HSR alignment along Melaka is locally prominent by phyllite, schist and slate. There will be no tunnel construction along the HSR alignment in Melaka. There is a potential environmental impact with the Graphitic schist that was discovered in Melaka (MK5B, MK6). The graphitic schist soils are characterised by highly acidic pore fluids, with pH values ranging from 1.22- 4.21, with the majority of values being < 2. The cause of the high acidity of the graphitic schist soils is now well known, even to the highway or geotechnical engineers. Graphitic schists contain a high amount of pyrite, which on exposure to the elements undergoes oxidation and hydrolysis reactions producing sulphuric acid and iron oxides/hydroxides. The practical implications of these chemical reactions are failures in turfing of cut slopes due to highly acidic soils, ugly staining (brown / red) of concrete pavements and drains due to the iron oxides / hydroxides released from the reactions, disintegration of the soil structure (hence severe drop in soil shear strength) due to the reactions and further formations of other secondary minerals. Corrosion of steel reinforcements in concrete structures located in close proximity to the graphitic schist soils is also possible. Thus, the acidity of the graphitic schist soils affects engineering works in a direct manner, in particular the stability of the cut slopes.

F) Johor

- (i) Peat and marine clay is discovered mainly at the western side of Johor especially in Pontian, Batu Pahat, and Muar. Peat is usually found as an extremely loose, wet, unconsolidated surface deposit which forms an integral part of a wetland system. Peat area has been categorized as Class III area meaning that the area needs highly geotechnical restriction to be developed. The marine clay found in study area are soft to very hard according to Mackintosh Probe test. Based on the numbers of boreholes drilled along the HSR alignment (Phase 1B), there were three (3) boreholes namely BH7, BH8 and BH9 located on soft ground condition that can give a great problem in the stability of the rail track foundation. During Phase 2A site investigation, there were another four (4) boreholes ABH1, ABH4, ABH6 and ABH10 located in peat soil and very thick soft clay (maximum thickness of 27 m).

Peat and marine clay are problematic for HSR alignment due to large settlement and require ground improvement depending on the severity of the situation. They are highly compressible, very soft to soft subsoil materials with low bearing capacity and incapable of supporting the fill embankment. For such ground conditions depending on the thickness of compressible layer and height of fill, it is envisaged that ground improvement works are required to support the embankments.

Ground improvement options include removal of unsuitable material, dynamic replacement, prefabricated vertical drains, construction of stone columns and piled embankments.

- (i) Another environmental issue with constructing on peat area in Johor is the peat fire especially during prolong dry weather.
- (ii) The quaternary deposits in Johor is also consider as a production zone for groundwater. The data have also shown the groundwater level in this area is very shallow (close to the surface). The groundwater level and its chemistry will affect the foundation structure of the tracks and its stability.
- (iii) Two (2) tunnels construction are proposed namely Bukit Naning 1 and Bukit Naning 2. The total length of both tunnels is about 2.3 km and will be constructed under the 190 m

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high terrain. The tunnel will be constructed in sedimentary rocks that are comprised of different rock lithologies such as conglomerate, pebbly sandstone, sandstone and shale. Conglomerate, pebbly sandstone and sandstone are good aquifer formations (i.e. contain groundwater) and tunnel constructed in these formations will have a problem with groundwater seepage into the tunnel during excavation. Groundwater seepage may slow down the tunnel construction and may also influence the stability of the tunnel. Shale layer is soft and easily broken and crumble. The presence of shale (soft rock material) may induced the rock failure due to slippage along this soft geologic layer. This however is greatly influenced by the orientation of the plane. The engineering behaviour of these rock types are different, where conglomerate and sandstone are stronger and brittle while shale is softer and ductile. The interbedded of conglomerate / sandstone and shale behave differently to the excavation technique being employed in the construction of the Tunnel. For example, drill and blast excavation method faces challenges with layered conglomerate / sandstone and shale because different materials behave differently to this excavation technique. Highly dense rock distributes the blasting energy better to the surrounding rock while softer rocks such as shale can react as a damper (i.e. they absorb more energy from the explosive material). Weak layers of rocks on top of the tunnel roof may cause blocks to fall. It is even worse if the excavation is in the same direction as the dip of the meta-sedimentary bedding. This may influence the stand-up time of the unsupported span (active span). Stand-up time is referred to as the time span which an excavated active span can stand without any form of support or reinforcement. Good rock mass quality with better rock orientation in favour for tunnelling will have longer stand-up time.

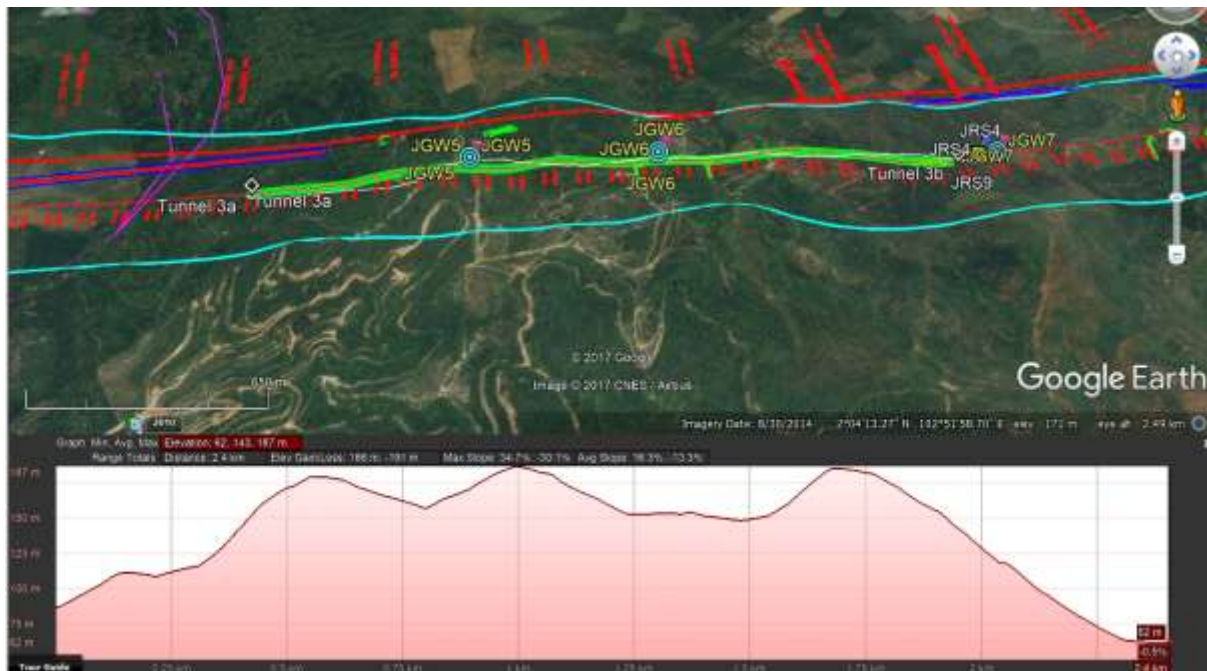


Figure 7-97: A proposed tunnel location in Muar, Johor with a length of 2.3 m and terrain elevation of 190 m

7.8.1.2.1 Slopes

The need to cut into natural ground arises from the fact that railway formations have to maintain relatively easier gradients than the prevailing ground slopes. A cutting is a permanently open excavation. The cut profile (or cutting) may pass through soils, rocks or a combination of both. There are several places along the HSR alignment where the slopes will be cut. Based on the feasibility study conducted for HSR project, there are eight (8) cut slopes in Selangor, 21 in Negeri Sembilan, 13 in Melaka and 27 in Johor. The main problem with the cut slope and embankment (fill) slope are due to erosion and slope failures.

7.8.1.2.2 Ground treatment

Several States along the HSR alignment was discovered having problematic ground conditions that must be avoided and/or stabilised such as peat soil and marine clay. **Table 7-39** shows the locations of problematic ground condition at four (4) States namely Selangor, Negeri Sembilan, Melaka and Johor.

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Table 7-40: Locations of Problematic Ground Conditions along the HSR Alignment

| BH ref. No. | States | Stratification | | |
|------------------|----------------------------|-----------------------------|-----------------|-----------|
| | | Description | Depth (M) | SPT |
| BH 1 | Selangor | Stiff sandy SILT V | 0 to 5 | 8 |
| | | Stiff sandy SILT | 5 to 12 | 26 to 30 |
| BH 2 | Negeri Sembilan | Firm sandy SILT | 0 to 25 | 5 to 6 |
| | | Granite | > 25 m | - |
| | | Stiff sandy SILT | 0 to 2 | 10 |
| BH 3 | Melaka | MD Gvly SAND | 3 to 5 | 18 to 37 |
| | | Hard sandy SILT | 5 to 19 m | 31 to 32 |
| Firm sandy CLAY | | 0 to 3 | 5 | |
| BH 4 | | Dense Gvly SAND | 3 to 6 | 32 to 35 |
| | | VD Gvly SAND | > 6 | > 50 |
| | | Very soft sandy CLAY | 0 to 6 | 1 to 2 |
| BH 5 | | Stiff CLAY with sand | 6 to 10 | 8 to 10 |
| | | Hard SILT | 10 to 15 | > 50 |
| | | Soft to Firm CLAY | 0 to 9 | 2 to 6 |
| BH 6 | | Johor | Hard sandy SILT | 9 to 19.5 |
| | Hard SILT with SAND | | > 19.5 | > 50 |
| | | | | |
| PEAT Firm | 0 to 9 | | xx | |
| BH 7 | sandy SILT L to | | 9 to 12 | 4 to 5 |
| | MD SAND Stiff to | | 12 to 18 | 4 to 18 |
| | V stiff SILT | | 18 to 28 | 12 to 28 |
| | | | | |
| | Very soft CLAY Firm | | 2 to 18 | 1 to 3 |
| | sandy SILT | | 18 to 21 | 6 to 7 |
| | Hard sandy SILT | | > 21 | > 50 |
| | PEAT Very | | 0 to 2 | |
| BH 8 | soft CLAY Firm | | 2 to 18 | 1 to 3 |
| | sandy SILT | | 18 to 21 | 6 to 7 |
| | Hard sandy SILT | | > 21 | > 50 |
| | PEAT V | | 0 to 7 | |
| | soft to soft CLAY | | 7 to 16 | 1 to 6 |
| BH 9 | Firm CLAY V | | 16 to 22 | 5 to 7 |
| | stiff SILT Hard | | 22 to 26 | 16 to 17 |
| | SILT | | > 26 | > 50 |
| | V soft CLAY | 0 to 8.0 | 1 | |
| | Firm SILT / CLAY | 8.0 to 21 | 5 to 8 | |
| | V stiff sandy SILT | 21 to 23 | 34 | |

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| BH ref. No. | States | Stratification | | |
|-------------|--------|-----------------------------|-----------|----------|
| | | Description | Depth (M) | SPT |
| BH 12 | | Hard SILT | > 23 | > 50 |
| | | Very soft sandy CLAY | 0 to 6 | 1 to 4 |
| | | Stiff to V stiff SILT | 6 to 10 | 10 to 17 |
| | | Hard SILT | > 10 | > 50 |

Note: V – Very , MD – Moderately, Gvly – Gravelly

7.8.1.3 Operational Phase

- (i) Impact to groundwater are expected to be minimal
- (ii) Impact of fire risk in peat soil areas is expected to be minimal

7.8.2 Hydrogeology

Groundwater system in the HSR Project area generally seems to have insignificant roles in term of provisioning services for the local community nearby. However, it may be contributing significant and important roles in providing a physical regulating service in the hydrologic cycle and in providing a sustainable local ecosystem in terms of supporting fauna and flora population. Hence, an assessment of the potential impacts of the construction and operation of the HSR Project on the groundwater environment in terms of water quality and quantity in the vicinity and downstream of the railway infrastructure is important.

7.8.2.1 Pre-Construction Phase

There will be no significant impacts of pre-construction activities of the Project to hydrogeology and groundwater environment of the area.

7.8.2.2 Construction Phase

Change in Groundwater Levels due to Underground Excavation (Tunnelling) and Ground Compaction (Foundation)

Tunnels excavation in soils or rocks may produce hydrogeological barrier that cause disturbance to the natural groundwater flow. Water seepage into tunnels during its construction may temporarily reduce groundwater level in the vicinity area. However, the impacts would be eliminated when the wall of the structures is grouted and concreted. Subsequently, the water-resistant tunnels may also cause some variation in local groundwater level. As the HSR alignment is generally crossing the main local direction of groundwater flow, the groundwater level in the upstream of groundwater flow may raise while the level in the downstream nearby may be lowered. The behaviour on the natural groundwater hydrodynamic that lead to rising-lowering groundwater level is inspired by size of the tunnel and its position or depth in reference to the groundwater level.

Ground compaction for the foundation of the HSR will also be introducing hydrogeological barrier crossing the main groundwater flow. Excavation of soft grounds such as peats and replacing with fine grained materials or soils for compaction will be developing long continuous impervious blockage that prevent the natural groundwater flow. A significant

change in groundwater level due to disruption in groundwater movement, in peats area in particular, may cause serious environmental impacts such as peat firing and flooding.

Contamination of Groundwater

It can be assumed that potential groundwater contamination during the Project construction will be minimal. However, the potential source of contaminant from the uncontrolled runoff or accidental spillage of fuels and lubricants, or from the inadequate or unsafe disposal of sanitary wastewater from construction sites should not be completely avoided. Moreover, the HSR is constructed on the potential surficial groundwater recharge areas that characterises by underlying rocks of various degrees of permeability from low-moderate (meta-sedimentary rocks) to very high (peat).

7.8.2.3 Operational Phase

Change in Groundwater Levels due to Development of Hydrogeological Barriers

The change in groundwater level and flow due to the construction of tunnel may be minimal if the groundwater is still allowed to flow towards its natural direction. However, the compacted HSR foundation replacing the original soft and high permeable ground will completely blockage and permanently prevent the natural groundwater flow. As the structure remain for the high speed train operation, it will permanently incite for the subsequent impacts such as peats firing due to significant reduction in groundwater level on one side and flooding due to groundwater level rise on the other side.

7.9 HYDROLOGY

7.9.1 Pre-Construction Phase

At pre-construction phase, the Project begins with survey, additional feasibility study, site investigation, utility mapping, utility relocation and Land Acquisition. During this phase, there will not be any significant impact affecting the hydrology section at all locations with regards to the Project.

7.9.2 Construction Phase

This section shall discuss the evaluation of impact arising from activities that will be carried out during construction of the HSR Project. These impacts are predicted based on the existing physical and environment change due to the Project.

The main activities that will be carried out by the Project Proponent are listed but not limited to below:

Project Activities during Construction

| Main Project Activities | Sub-Project Activities |
|-------------------------|---|
| Survey & Investigation | Land Clearing |
| | Demolition |
| | Construction Of Access Roads |
| | Earthwork |
| | Drainage |
| | Transportation Of Materials / Equipment |
| | Vehicle Movemen |
| | Traffic Diversion |
| | Disposal Of Unsuitable Material |
| | Waste / Wastewater Generation |
| | Disposal Of Solid And Construction Waste / Biomass |
| | Establishment Of Site Office, Storage Areas |
| | Establishment Of Workers Camp |
| | Piling |
| | Construction Of Station / Depots / Maintenance Base |
| | Construction Of Elevated Structures |
| | Construction Of At-Grade Structures |
| | Utilities Relocation |
| | Employment Of Workers And Staff |
| | Business Development |
| | Abandonment |

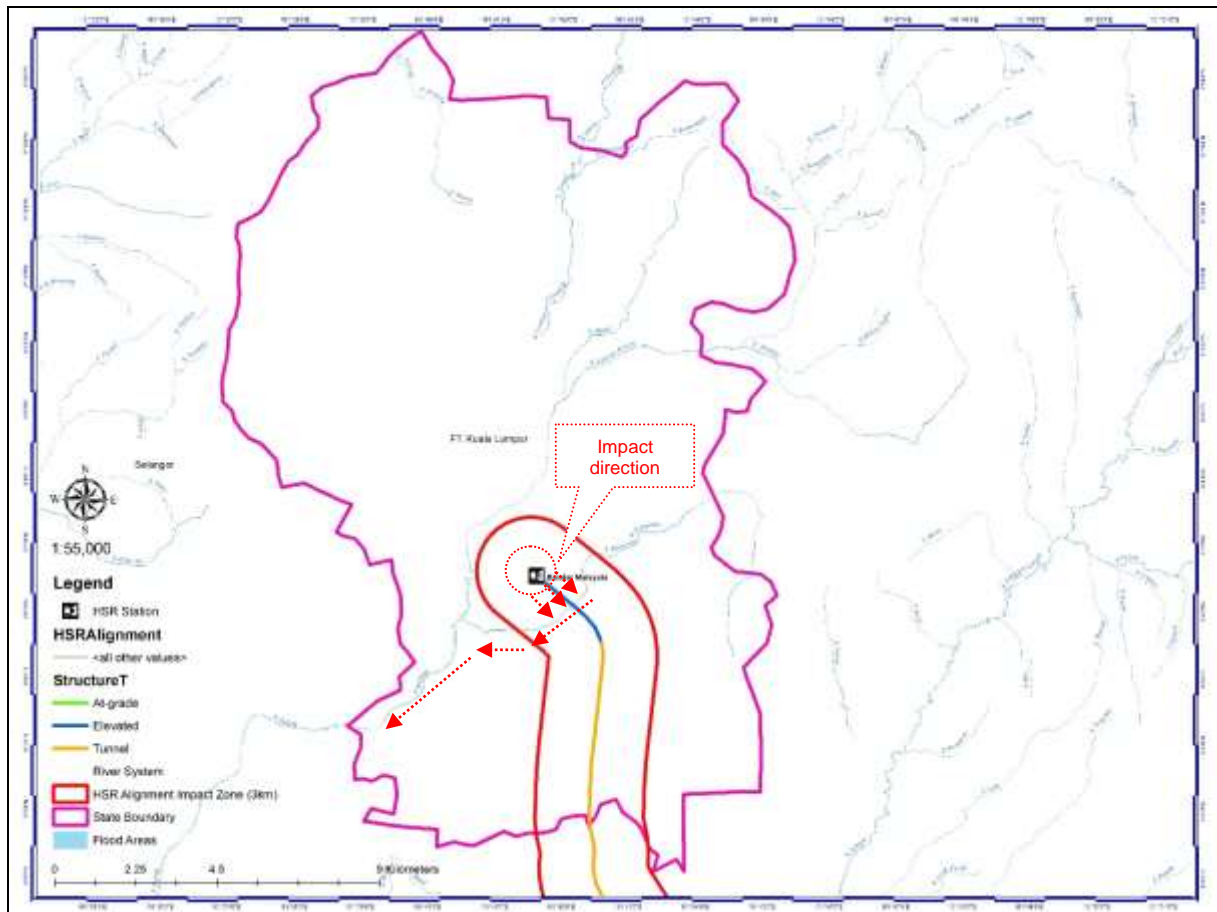
CHAPTER 7: EVALUATION OF IMPACTS

7.9.2.1 FT. Kuala Lumpur

There are several activities associated with the construction of the HSR project that are expected to cause hydrological impacts in FT. Kuala Lumpur. The activities which have been identified are as follows:

Project Activities and hydrological impacts in FT. Kuala Lumpur

| No. | Project Activities | Hydrological Impacts |
|-----|---|---|
| 1. | Construction of Bandar Malaysia Station | <ul style="list-style-type: none"> • Increase in sediment concentration into the drainage / river system (Sg. Kerayong and flow out to Sg. Klang) • Eroded soil particles that are suspended in flowing runoff waters will be transported offsite. • Increase in surface runoff. |
| 2. | Construction of HSR alignment structures (type proposed is elevated and tunnel) | Minimal impact from elevated structures. |
| 3. | Earthworks | Increase in surface erosion and sedimentation due to site clearing activities |



Source: Department of Survey and Mapping Malaysia

Figure 7-98: Construction proposed and HSR alignment structures type with hydrology aspect in FT. Kuala Lumpur

The predicted impacts on the hydrological characteristics for the above-mentioned activities and site location are as follows. The impact on hydrological characteristics due the earthworks and construction activities are severe especially during wet seasons if mitigation measures proposed in the Land Disturbing, Pollution Prevention and Mitigation Measures (LD-P2M2) are not being implemented. The sediment from loose soils, open space, earthworks, land clearing and construction works will be transported into the adjacent drain before being released into Sg. Kerayong and flow out to Sg. Klang.

The construction of Bandar Malaysia Station can result in soil erosion due to rain, increasing the sediment load in the river during the period of construction. Piling activity also can lead to soil instability and soil erosion. Since the area involved is quite small, the increase in sediment load to the river is expected to be relatively small. However, any earthwork activities close to Sg. Kerayong must take into consideration of their low lying floodplain.

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Clearing the area can accelerate river flow, hence increase flash flood in the river mouth in Sg. Klang.

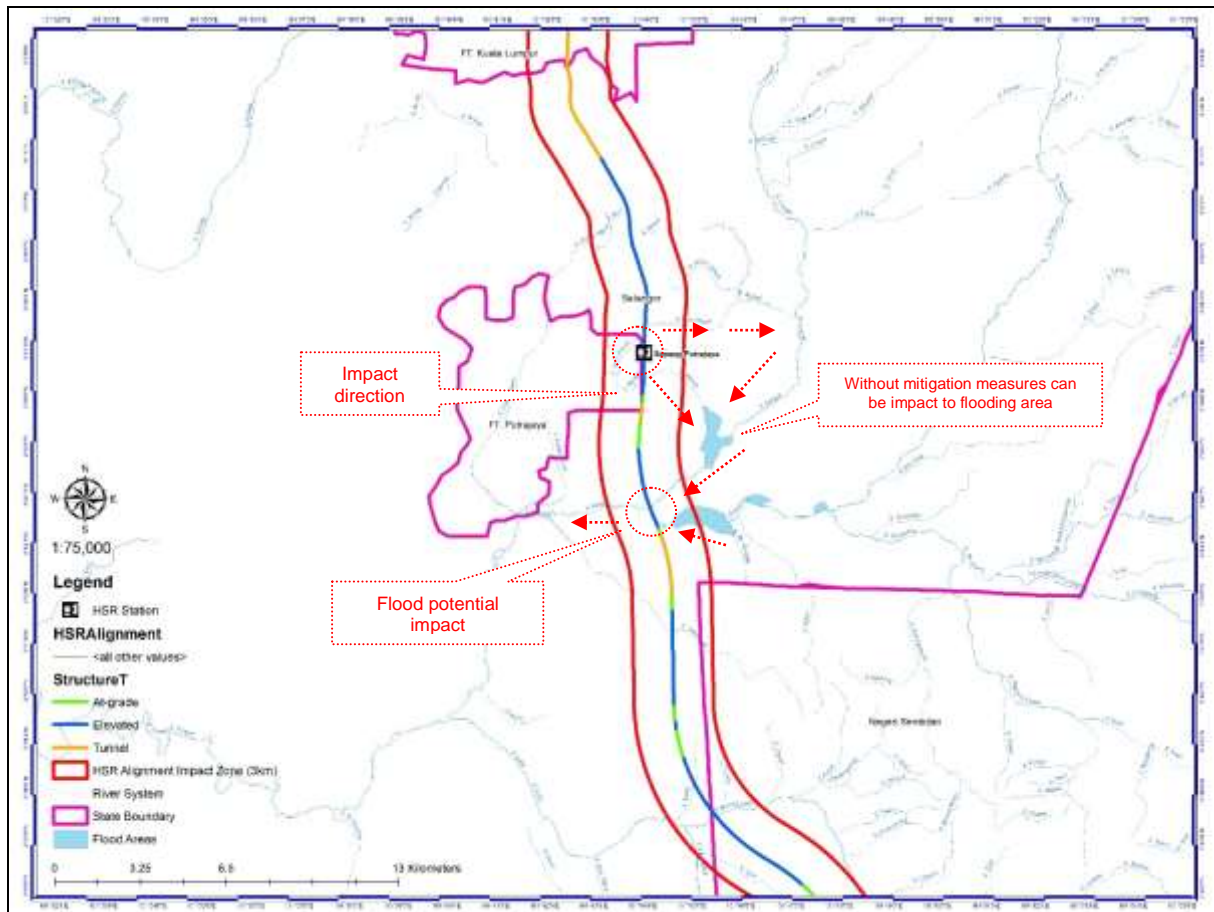
7.9.2.2 Selangor and FT. Putrajaya

For Selangor and FT. Putrajaya, there are several activities associated with the construction of the HSR project that are expected to produce hydrological impacts. The activities, which have been identified, are as follows:

Project Activities and Hydrological Impacts in Selangor and FT. Putrajaya

| No. | Project Activities | Hydrological Impacts |
|-----|---|--|
| 1. | Construction of Sepang-Putrajaya Station | <ul style="list-style-type: none"> • Increase in sediment concentration into the drainage / rivers system (Sg. Ayer Hitam to Sg. Ramal and Sg. Merab to Sg. Langat). • Increase in potential of localise flooding mainly closed to Sg. Merab (please refer to Figure 7-99). |
| 2. | Construction of HSR alignment structures (type proposed is elevated, At-grade and tunnel) | <ul style="list-style-type: none"> • Minimal impact from elevated structures. • Localised flood is reported adjacent to Kg. Sg. Buah, PPRT Ampar Tenar, Jenderam Hulu and Salak Tengah with flood maximum depth 0.3 m to 1.6 m. |
| 3. | Earthworks | <ul style="list-style-type: none"> • Increase in surface erosion and sedimentation due to site clearing activities |
| 4. | Land Clearing | <ul style="list-style-type: none"> • Increase in sediment concentration into Sg. Merab to Sg. Langat. |

In Selangor and FT. Putrajaya, the construction of Sepang-Putrajaya Station is expected to increase the sediment concentration, especially during the wet seasons. During this period, the sediment from loose soils, earthworks, land clearing and construction works will be transported into the adjacent drainage before released into Sg. Langat.



Source: Department of Survey and Mapping Malaysia

Figure 7-99: Construction proposed and HSR alignment structures type with hydrology aspect in Selangor and FT. Putrajaya

Changes in stream morphology could result in higher velocities thus increasing the potential of soil erosion in the stream channels. There is also the potential for soil erosion on embankments and in roadside ditches (scour) especially near the railway crossing.

7.9.2.3 Negeri Sembilan

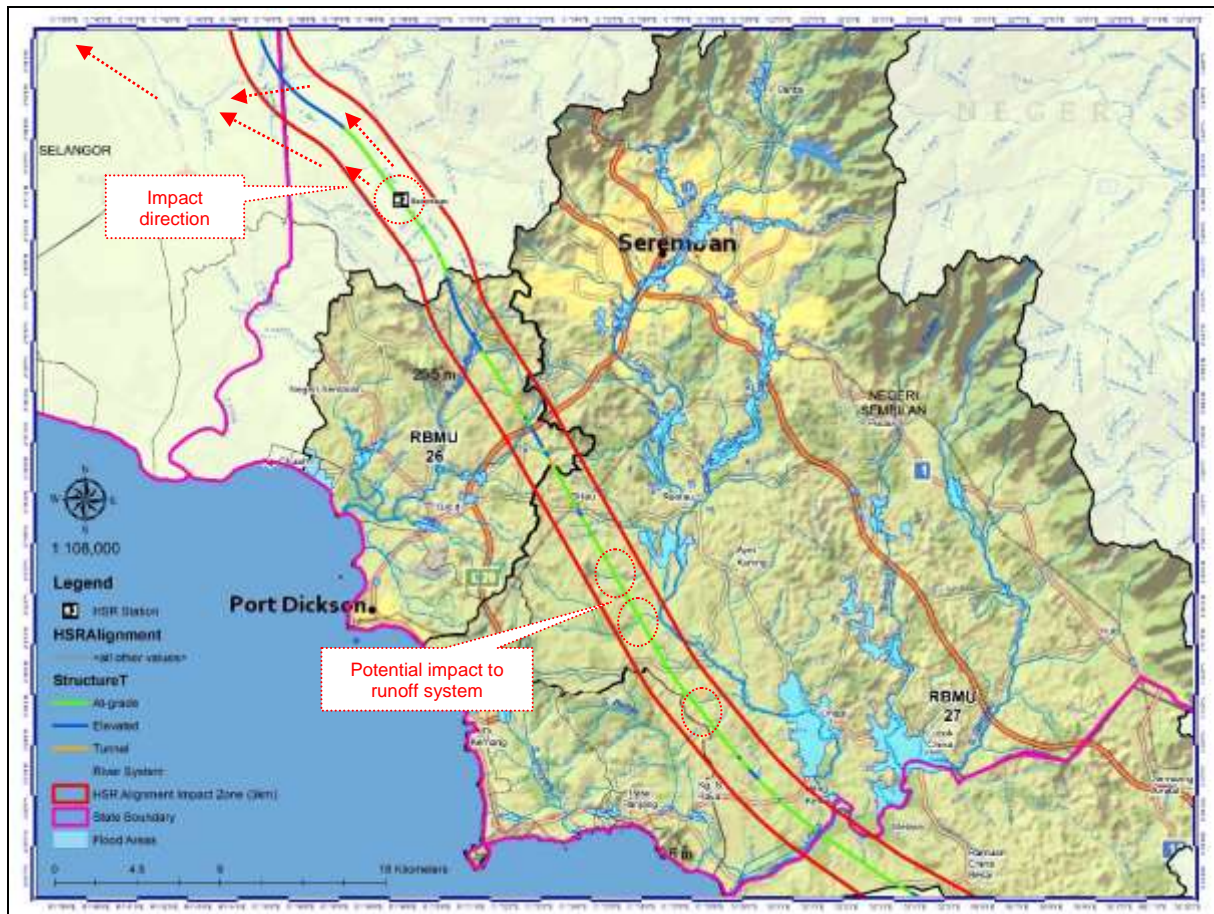
The nature of impacts on the environment for the above-mentioned activities is outlined for sediment transport into the near drainage and river system. However, there are also have several activities associated with the construction of the HSR project that are expected to produce hydrological impacts. The activities, which have been identified, are as follows:

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Project Activities and Hydrological Impacts in Negeri Sembilan

| No. | Project Activities | Hydrological Impacts |
|-----|---|--|
| 1. | Construction of Seremban Station | <ul style="list-style-type: none"> • Increase in sediment concentration especially during wet seasons. • Increase in sediment transport into the adjacent drainage / river system (Sg. Jijan flow to Sg. Labu and flow out to Sg. Langat) (Please refer to Figure 7-100). |
| 2. | Construction of HSR alignment structures (proposed type is At-grade, elevated and tunnel) | <ul style="list-style-type: none"> • Minimal impact from elevated structures. • At-grade type for HSR alignment without proper drainage system will be affecting the runoff system in this location. • Blockage of streams due to the accumulation of soil and plant debris would cause the stream to overflow. (Please refer to Figure 7-100). |
| 3. | Earthworks | - Increase in soil erosion and sedimentation due to site clearing activities |
| 4. | Land Clearing | - The sediment from loose soils, earthworks, land clearing and construction works would be transported into the adjacent drainage before being released into Sg. Linggi. |

In Negeri Sembilan segment, the construction of Seremban Station is located in low lying ground within the proposed MVV Development, approximately 2.5 km west from Labu town and 14 km north-west of Seremban city centre. The Seremban Station is At-Grade and hence, embankment is required. The Station is predicted to be connected by roads from Jalan Labu and Bandar Enstek which can increase the sediment concentration into Sg. Linggi.



Source: Department of Survey and Mapping Malaysia

Figure 7-100: Construction proposed and HSR alignment structures type with hydrology aspect in Negeri Sembilan

Site clearing for Seremban Station which involves cutting and removal of biomass are among major activities that can lead to higher sediment flowing into Sg. Linggi. Improper design of drainage system during site clearing could lead to increase runoff and flash flood at the site. Blockage of streams due to the accumulation of soil and plant debris would cause the stream to overflow onto its bank. The development of HSR Project area would also increase impermeable which results in increased specific peak runoff. The small streams and any tributary of Sg. Linggi would then be transformed into a main drain and flows into Sg. Linggi. At present, bankfull discharge (Q) was frequently reported by local farmers which cause destruction on their crops along the river bank.

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7.9.2.4 Melaka

There are several activities associated with the construction of the HSR project that are expected to produce hydrological impacts in Melaka. The activities which have been identified are as follows:

Project Activities and Hydrological Impacts in Melaka

| No. | Project Activities | Hydrological Impacts |
|-----|---|--|
| 1. | Construction of Melaka Station | <ul style="list-style-type: none"> - Increase in sediment concentration especially during the wet seasons. - Increase in sediment transport into the drainage / river system (Sg. Anak Ayer Pdg. Keladi flow to Sg. Durian Tunggal and flow out to Sg. Melaka). (please refer to Figure 7-101). |
| 2. | Construction of HSR alignment structures (type proposed is At-grade and elevated) | <ul style="list-style-type: none"> • Minimal impact from elevated structures. • At-grade type for HSR alignment without proper drainage system will be affecting the runoff system in this location. • Blockage of streams due to the accumulation of soil and plant debris would cause the stream to overflow its bank. • Impact of flooding areas in Melaka such as in Sg. Baharu River Basin, Sg. Duyung River Basin and Sg. Kersang River Basin. The elevated structures type with minimum pillar for HSR Alignment in surrounding areas is proposed to minimize flood flow and flood debris impact. • (please refer to Figure 7-101). |
| 3. | Earthworks | <ul style="list-style-type: none"> - Increase in soil erosion and sedimentation due to site clearing activities |
| 4. | Land Clearing | <ul style="list-style-type: none"> - Increase in sediment from loose soils, earthworks, land clearing and construction |

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| No. | Project Activities | Hydrological Impacts |
|-----|--------------------|---|
| | | works to be transported into the adjacent drainage before being released into main river. |

The nature of impacts on the environment for the above-mentioned activities is outlined for sediment transport into the near drainage and river system. For the Melaka Station, the HSR Station is elevated, across Jalan Spa-Lebuh Ayer Keroh dual carriageway state road and is proposed to be as a potential 'gateway' into Melaka. The land profile is undulating, within the sloping terrain of IOI Plantations property. The construction of Melaka Station will potentially impact sediment concentration especially during wet seasons.



Source: Department of Survey and Mapping Malaysia

Figure 7-101: Construction proposed and HSR alignment structures type with hydrology aspect in Melaka

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Sediment from loose soils, earthworks, land clearing and construction work would be transported into the adjacent drainage before being released into Sg Bemban. Slope erosion and sedimentation may also increase due to site clearing activities. During the tree cutting for access roads, land clearing and earthworks for construction of the Melaka Station would cause serious surface erosion and sedimentation problems if it is not planned properly. The Melaka Station is an elevated structure located at Melaka International Motor Circuit (MIMC). Thus, minimal tree cutting for access roads will be required as the access roads for the project will be expected from the existing roads to MIMC. Minimal land clearing is expected as well. When eroded soil particles is washed downstream, it can reduce the quality of water for irrigation and local treatment and diminish their efficiency, thus increase the costs of maintenance for the water.

7.9.2.5 Johor

There are several activities associated with the construction of the HSR project that are expected to produce hydrological impacts in Johor segment. The activities which have been identified are as follows:

Project Activities and Hydrological Impacts in Johor

| No. | Project Activities | Hydrological Impacts |
|-----|------------------------------------|--|
| 1. | Construction of Muar Station | <ul style="list-style-type: none"> • Increase in sediment concentration especially during wet seasons. • Increase in sediment transport into the drainage / river system (Sg. Pagoh and flow out to Sg. Muar). • The Muar Station is close to flooding areas as reported in Sg. Muar. (Please refer to Figure 7-102). |
| 2. | Construction of Batu Pahat Station | <ul style="list-style-type: none"> • Increase in sediment concentration especially during wet seasons. • Increase in sediment transport into the drainage / river system (Sg. Simpang Kanan and flow out to Sg. Simpang Kiri). • The Batu Pahat Station is located within |

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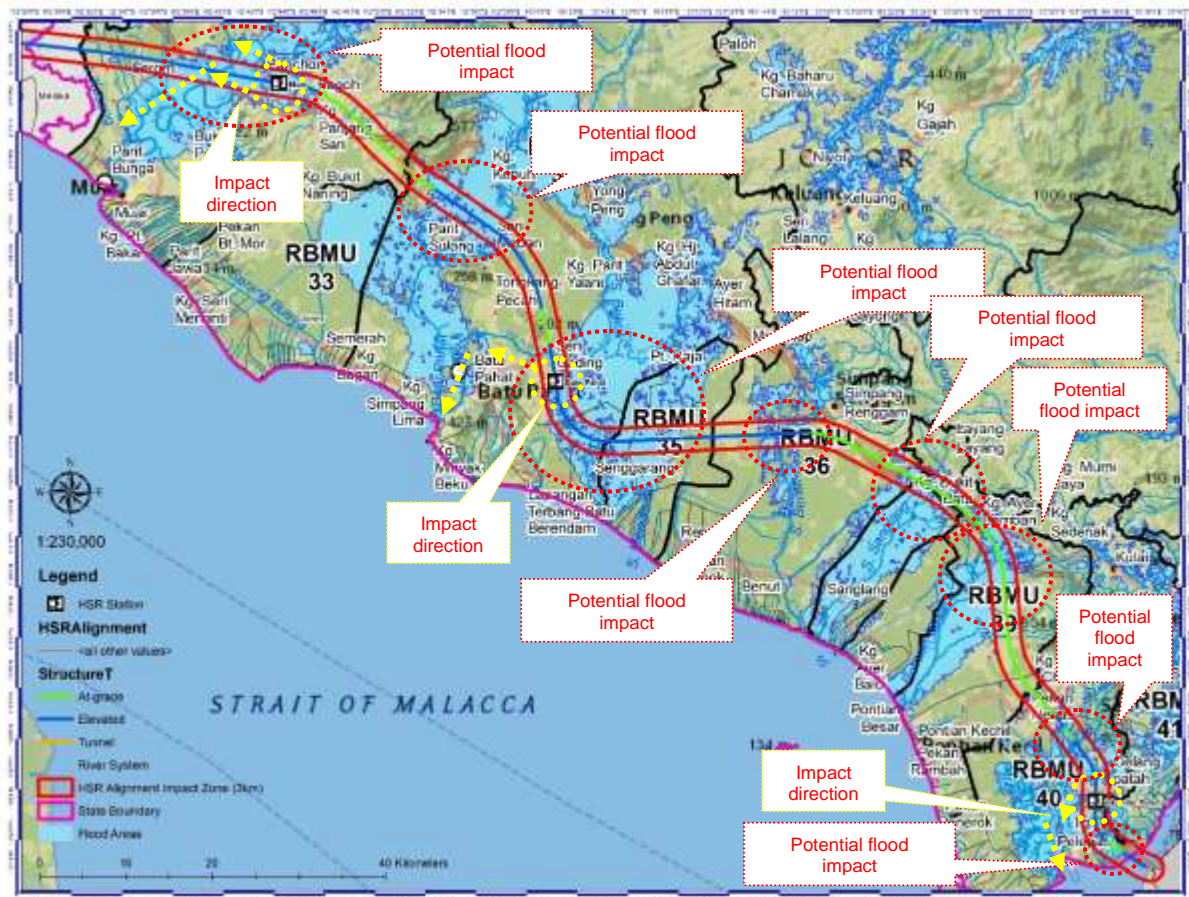
| No. | Project Activities | Hydrological Impacts |
|-----|---|---|
| | | <p>the flooding areas as reported in Sg. Senggarang.</p> <p>(Please refer to Figure 7-102).</p> |
| 3. | Construction of Iskandar Puteri Station | <ul style="list-style-type: none"> • Increase in sediment concentration especially during wet seasons. • Increase in sediment transport into the drainage / river system (Sg. Arang and flow out to Sg. Pulai). <p>(Please refer to Figure 7-102).</p> |
| 4. | Construction of HSR alignment structures (type proposed is elevated, at-grade and Tunnel) | <ul style="list-style-type: none"> • Minimal impact from elevated structures. • Minimal impact from tunnel structures. • At-grade type for HSR alignment without proper drainage system will be affecting the runoff system in this location. • Blockage of streams due to the accumulation of soil and plant debris would cause the stream to overflow to its bank. • Impact of flooding areas in Johor such as in Sg. Sanglang River Basin, Sg. Pontian Besar River Basin and Sg. Pulai River Basin. The elevated structures type with minimum number of pillars for HSR Alignment at the surrounding areas is proposed to minimise the potential of flood flows and flood debris impacts. <p>(Please refer to Figure 7-102).</p> |
| 5. | Earthworks | <ul style="list-style-type: none"> • Increase in soil erosion and sedimentation due to site clearing activities |
| 6. | Land Clearing | <ul style="list-style-type: none"> • The sediment from loose soils, earthworks, land clearing and construction works would be transported into the adjacent drainage before being released into main river. |

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In Johor segment, for construction activity for Muar Station, sediment from loose soils, earthworks, land clearing and construction works would be transported into the adjacent Sg. Pagoh before being released into Sg. Muar.

The construction of Batu Pahat Station may also increase the sedimentation value where the source comes from loose soils, earthworks, land clearing and the construction works. The sediment would be transported into Sg. Simpang Kanan.

For Iskandar Puteri Station, sediment from loose soils, earthworks, land clearing and construction works would be transported into the adjacent tributary of Sg. Pulai before being released into main of Sg. Pulai and flow out to the sea.



Source: Department of Survey and Mapping Malaysia

Figure 7-102: Construction proposed and HSR alignment structures type with hydrology aspect in Johor

All the HSR station in Johor i.e. Muar, Batu Pahat and Iskandar Puteri is an elevated structure. Land clearing and earthworks for construction of Muar and Batu Pahat Stations and access roads may cause serious surface erosion and sedimentation problems. When eroded soil particles is washed downstream, it can reduce the quality of water for irrigation and reduce the efficiency of downstream water treatment and increase the costs of maintenance. Any land clearance on the upstream site would increase sediment load and destroy the river system. However for Iskandar Puteri station, since it is an international station that provides more service than other HSR stations which is express, shuttle and domestic service, thus the footprint of the station will be bigger, thus it may be a significant contributor to the increase of sedimentation.

7.9.3 Operational Phase

During operation of HSR Project, minimal impacts on environmental hydrology are predicted along the HSR alignment. However, significant impact is predicted, especially to the all HSR Stations, Depots and Maintenance Bases activities if waste / wastewater generation is not properly managed, thus will be affecting the river ecosystems, river flow, river capacity and potential of flash flood. At-grade structure type for HSR alignment without proper maintenance will affect the runoff system in this location. Blockage of streams due to the accumulation of soil and any debris would cause the stream to overflow its bank. Example of flood debris impact to the worse case flood in Malaysia is as shown in **Figure 7-103**. For localise flood, impact of flooding areas to all elevated structures type is very minimal as the elevated structure design has taken into consideration the maximum flood magnitude proposed on the areas.

Depot and Maintenance Base for the HSR project are as follows:

1. Light Depot and Light Maintenance Base (LMB), Serdang
2. Heavy Maintenance Base (HMB), Muar and
3. Main Depot and Light Maintenance Base (LMB), Pontian

It has been reported that future climate changes may increase rainfall intensity and frequency resulting in higher flooding potentials. Therefore, the project has identified that the alignment will be supported on elevated structure as it traverses through current potential flooding areas.

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Source: bharian.com.my, Yahoo News Singapore, Berita Harian, and MyNewsHub)

Figure 7-103: Flood debris impact to the worst case flood in Malaysia

7.10 TERRESTRIAL ECOLOGY IMPACTS

7.10.1 Construction Phase

The following activities are expected to have significant impacts on flora and fauna during the construction phase of the HSR Project:

- Land clearing and earthworks
- Construction of access roads
- Works at and over river crossings
- Works at mangrove areas
- Works at forest reserves (Sg. Pulai)
- Works at or near habitable areas
- Construction of stations depots, tunnels, elevated structure and at-grade structures
- Project abandonment

Loss of Biomass and Habitat of Small Animals

Since the majority (75% to 80%) of the HSR alignment will traverse through tree crop plantations, i.e. rubber and oil palm estates/small holders, route clearance to construct the rail lines will result in the generation of significant amounts of rubber and oil palm biomass which has to be adequately managed in order to prevent adverse environmental impacts. It has been assumed that the mass unit rate of oil palm and rubber is 47 tones/ha and 96.12 tonnes/ha respectively. The anticipated amounts of biomass that is expected be cleared during the construction phase is summarized in **Table 7-18**. Details of land clearing and earthworks are discussed above under **Section 7.5**.

The clearing of land for the construction of the HSR alignment structures, Stations and Depots and Maintenance Bases and construction of temporary access roads will result in the loss of biomass (primarily oil palm and rubber trees), which are home to many monkey and small animal species within the corridor. The loss and/or disruption of flora and fauna and their habitats due to this are expected to be minimal and temporary, basically confined to the project footprint and the access roads only.

In general, much of the areas surrounding the HSR alignment comprises of plantation areas cultivating oil palm and rubber tree crops. Urban settlements and commercial centres are scattered along the alignment as it traverses the FT. Kuala Lumpur, Selangor, FT. Putrajaya, Negeri Sembilan, Melaka and Johor. The biological components present are common, and are representative of commensal fauna species, ornamentals and other cultivated plant species typically found in disturbed, cultivated and urban habitats. These species are easily replaceable.

Land and Habitat Fragmentation

The HSR alignment, stations and associated facilities are chosen to avoid environmental sensitive areas (ESA) during the feasibility study. Natural parks, pristine forest, wetland, steep land and hill stations are avoided where possible. Where crossing over steep slope, road, TNB pylon, river, swampy and soft soils such as peat area cannot be avoided, minimisation of soil erosion impact will be undertaken by use of viaduct, long-span superstructure, bridge or tunnel to minimise the area of disturbance.

Construction of the At-Grade structure will cause fragmentation of land and habitat in forest areas, causing animal species and their feeding grounds to be divided into either side of the HSR alignment. These animals will not be able to move from one side of the alignment to the other due to the possible presence of fencing / barriers along the alignment (if deemed necessary by the Project Proponent). If there are no fences or barriers along the at-grade sections of the HSR alignment, animals that try to cross the railway tracks face the risk of being hit and killed by the high-speed trains. The impacts of land and habitat fragmentation, however, is not significant as the At-Grade sections of the HSR alignment passes majority through agriculture and plantation areas and forest areas, whereby there is no presence of large animals like tigers or elephants.

Impact on Wildlife Species

The HSR alignment does not encroach into any forest areas. However, the alignment is approximately 400 m from the fringe of the Bukit Bindu Forest Reserve in Johor that houses a family of three individuals of the Lembu Bali (*Bos javanicus*) that was recorded by camera trapping in Bukit Bindu Forest. This species which originated from Indonesia and is a commercial species, has been confirmed by Jabatan PERHILITAN to have escaped from a

failed breeding programme to cross the *Lembu Bali* with the domesticated cattle, previously attempted by one of the nearby villagers. It is not known how far into or out of the forest reserve this species wanders. Therefore, appropriate measures should be in place to ensure that construction activities do not adversely impact this species and other protected wildlife.

Disturbance to Mangrove Ecosystem

The loss of mangrove cover will affect existing wildlife population (such as primates, small mammals and herpetofauna) inhabiting that particular area (**Figure 7-104 to 7-105**). As many animal species show territorial habit, migration of any wildlife from the Project area to adjacent areas will add more pressure on the wildlife population of the adjacent natural areas (e.g. mangroves), which are already under much human-induced pressures within the downstream parts of certain river catchments. However, site clearing, tunnelling and earthworks activities for the HSR Project are expected to be minimal and confined only to the access roads and the project footprint, where much of the flora comprise disturbed composites (shrubs, climbers, weeds and back mangroves) and cultivated species (mainly rubber and oil palm) of little conservation interest. **Figure 7-106** shown the alignment traverses at the frindge of the Sg. Pulai Forest Reserve which involves approximately 4.4 ha.

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| | |
|--|---|
|  |  |
| <p><i>Exoecaria agallocha</i> (Buta-buta)</p> | <p><i>Sonneratia ovata</i> (Gedabu)</p> |
|  |  |
| <p><i>Ceriops tagal</i> (Tengar)</p> | <p><i>Xylocarpus granatum</i> (Nyireh Udang)</p> |
|  | |
| <p><i>Sonneratia alba</i> (Perepat)</p> | |

Figure 7-104: Mangrove flora at Sg Pulau



Figure 7-105: Mangrove forest fronting Tebrau Strait

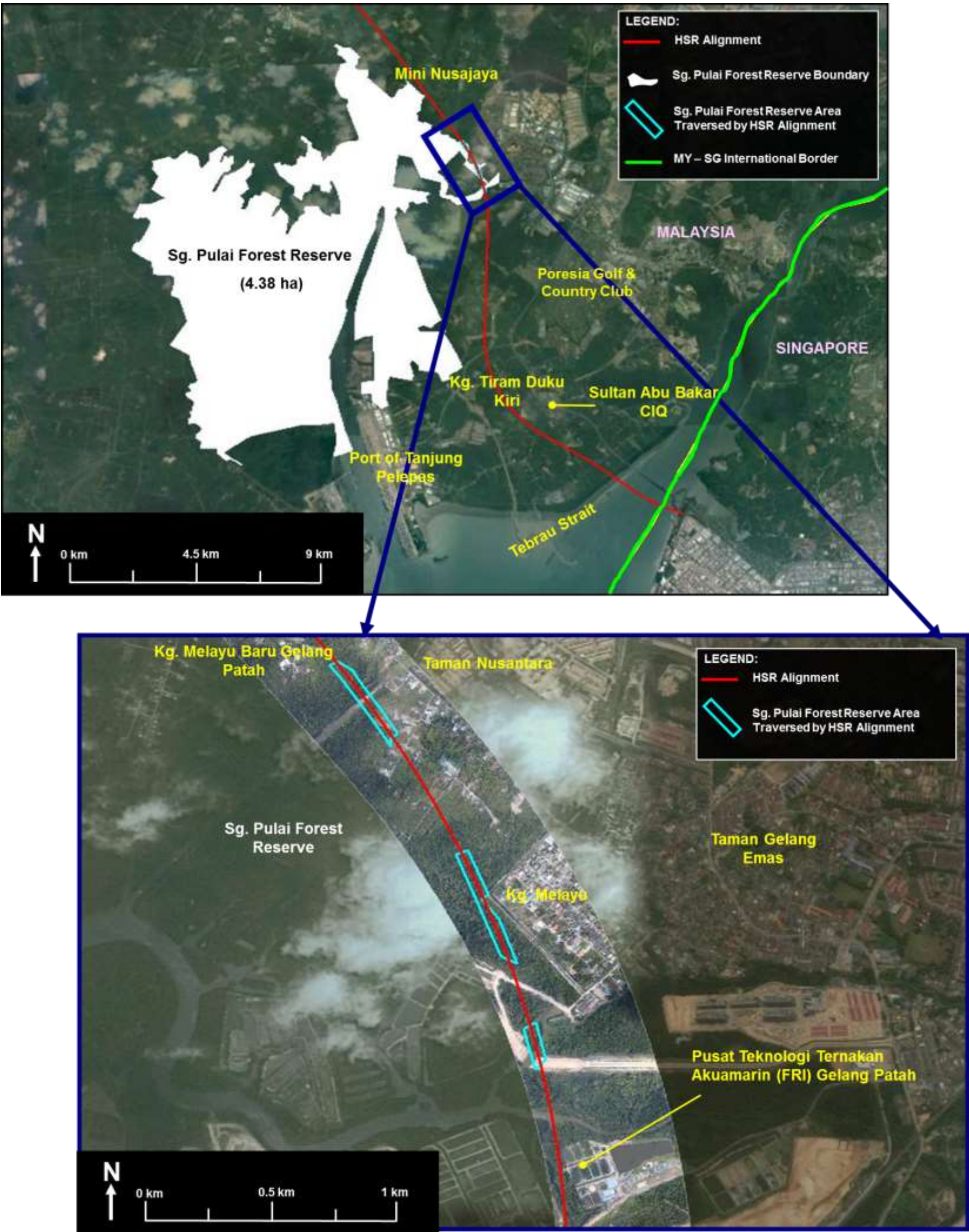


Figure 7-106: HSR alignment crossing Sg. Pulai Forest Reserve (50m corridor)

Spreading of Diseases and Viruses

Land clearing of forests and swamp areas is directly related to the potential of disease vectors migrating into nearby settlements, particularly with regards to *Aedes albopictus* and *Culex* species that may lead to disease outbreaks like dengue fever, malaria, filariasis and chikungunya. Larger vectors like rats and other rodents could transmit other diseases like leptospirosis, and scrub typhus.

Migration of Animals and Human-Wildlife Conflict

Larger mobile mammals (such as primates and wild pigs), birds and fishes could escape from the disrupted areas during land clearing (especially in the plantations and forest fringes) and migrate into adjacent surroundings. Based on the discussions with the Department of Wildlife and National Parks (PERHILITAN), the main concern that was highlighted was that the incidence of human-wildlife conflicts that could rise during the construction phase, such as increase in the number of wild pigs and monkeys preying on crops in cultivated fields and fruits in the orchards, and of pest primates and snakes entering homes adjacent to the work sites. The exact locations of these impacts cannot be predicted, as they will occur along the entire alignment that passes through settlements and plantation areas.

7.10.2 Operational Phase

These following activities are expected to have significant impacts on flora and fauna during the operational phase of the HSR Project

- (a) Passing of trains through plantations and green areas
- (b) Landscaping Works
- (c) Abandonment

Land and Habitat Fragmentation

For all the states traversed by the HSR alignment, the presence of the [HSR](#) Project during its operational phase would permanently bisect contiguous habitats, causing habitat fragmentation and the creation of a linear barrier across the home range and feeding grounds of various wildlife species such as mammals, herpetofauna, etc. Habitat fragmentation reduces the size of available habitat for fauna and the cleared forest strip may

cause disorientation to large mammals. The affected population of any fauna species that are not able to cross the HSR alignment barrier (is deemed necessary by the Project Proponent) will be separated into several smaller populations. Small fragmented forest areas may not be suitable for large mammals to roam for food and shelter. Lack of food within the fragmented area will push animals to go outside the forest and cause conflict with/damage to the adjacent plantation and settlement areas. Attempts of the animals to cross the railways tracks (if there are no fences or barriers present) may also result in collision with the trains moving at high speed and an increased mortality rate of the animals.

Disturbance to Mangrove Areas and Ecosystem

In Negeri Sembilan, the Sg. Linggi Forest Reserve and likewise, in Johor, the Sg. Pulai Mangrove Reserve both have very good, stable and mature mangrove stands fronted by mudflats. These habitats provide invaluable ecosystem services as nursery grounds to support fishery resources, as stopover sites for migrating birds, for erosion control and for coastal protection against storm surges and sea level rise. The proximity of the HSR alignment and its associated facilities to these protected areas could encourage further encroachment and forest degradation if future developments are not properly controlled and planned.

Wildlife Collision

Collision and mortality of wildlife at elevated sections of the alignment is not an issue, as the animals do not have access to the railways tracks, while down below, they are free to roam about their natural home range. However, when the alignment is at-grade, it is possible that some stray animals will attempt to cross the at-grade alignment to get to the other side in search for food and shelter, whereby collision of wildlife/fauna with the high speed trains could occur.

Impacts of Enhancement due to Landscaping Works

For all the states traversed by the HSR alignment, landscaping and vegetation works of the exposed ground during the operation phase of the project utilising suitable choices of plant species will have positive impacts as it would facilitate ground stability and slope protection as the root zone of trees and shrubs would anchor the soft grounds, prevent surface erosion

and accelerate consolidation of the soil profile. The positive impacts of long term and permanent benefits pertains to slope/ soil and water quality protection, natural aesthetics, landscape and other ecological functions.

Health and Safety Risks due to Abandonment

For all the states traversed by the HSR alignment, any abandoned or damaged vehicles, equipment and uncompleted structures left onsite can pose health and safety hazards to the public, especially children, pets and domestic animals.

7.11 MARINE ECOLOGY

7.11.1 Construction Phase

The principal construction related activities that are capable of inducing environmental impacts include:

1. Transportation of materials and equipment by Barges
2. Disposal of solid and construction water/biomass
3. Piling Works

The potential impacts that could occur during the construction phase are assessed herewith.

7.11.1.1 Transportation of Materials and Equipment by Barges

Plankton: Any untreated discharge of sewage or wastewater into the marine environment would result in an increase in nutrients and organic matter in the receiving waters, which may increase phytoplankton biomass and potentially lead to eutrophication. Eutrophication is a condition in an aquatic ecosystem where high nutrient concentrations stimulate blooms of algae (e.g., phytoplankton). As an outcome, the algal blooms limit the amount of dissolved oxygen required for respiration by other animal and plant species in the water. Although in this case, the likelihood of waste/wastewater to be discharged into the marine area is very low, while the magnitude (amount of waste/ wastewater) would be small. Hence potential impacts are considered to be insignificant if proper mitigation measures are adopted as explained in the Chapter 8.

Fish Fauna: Potential impact to the water quality during the transportation includes wastewater discharge and accidental spillage or leakage of chemicals and fuel / oil into the marine environment. Nevertheless, these spillages are predicted to be minimal and the immediate impact on fish fauna would be migration of fish and free-swimming or mobile marine life to safer or less disturbed areas (generally deeper waters) as a natural response to changes in the marine environment (Wildish, D.J. & Power, J. (1985), Pennekamp, J. & Quuak, M. (1990)) thus avoiding direct deleterious effects.

7.11.1.2 Piling Works

Phytoplankton: Although temporary, the increased load of suspended sediment arising from piling activities may reduce light penetration and thus reduce the depth of photosynthetic activity by phytoplankton. However as has been predicted the induced suspended sediment concentrations will be below 5 mg/L throughout the piling activities. Literature review of plankton threshold limits to suspended sediments is generally much higher, with one study reporting a significant impact with suspended solids concentrations of more than 10 mg/L for exposure time over 1344 hours (Bilotta, G.S. Brazier, R.E. (2008)). Hence, the impact to phytoplankton and zooplankton communities due to increased suspended sediments is deemed insignificant.

Macrobenthos: Sediment communities have been found to play a critical role in the food chain for the marine organism (Chong, et al. (1990)). Benthic macrofauna are also one of the most important food sources for marine demersal fish Sasekumar, A. and C. Wilkinson. (1994), Erftemeyer, P et al. (1989)). Thus, the loss of macrobenthic fauna may impact fish fauna by disrupting the food chain.

The following thresholds have been used:

- Suspended sediment (primarily affecting filter feeders) – 25 mg/L
- Sedimentation - The sensitivity of benthic invertebrates to burial from siltation is species specific. Mobile species of polychaetes, bivalves, gastropods and crustaceans have been reported to be able to migrate between 2 – 26 cm during eight days after an acute burial by 32 cm of sand (Birklund, J. & Wijsman, J.W.M., (2005)). Mortality of most species was low in sand and high in silt.

Based on the above, considering the maximum suspended sediment plume concentration from the piling activity is predicted to be less than 5 mg/L, no impact is predicted. This is further supported due to the sandy sediments in the project area, which tend to settle quickly thus sedimentation during construction activities are negligible.

Crustaceans such as shrimps and molluscs (gastropod and bivalves), which have limited mobility and are largely dependent upon food and shelter on the foreshore area can be affected due to piling activities. This in turn, would reduce the abundance of these organisms. A study by Ingle (1952) reported that high levels of suspended sediments have been shown to kill bivalves. Other impacts arise from the disturbance of seabed are destruction of spawning areas and smothering or suffocation of sessile organisms in the area (Pennekamp, J. & Quak, M. (1990)).

The predicted sediment plume excursion due to piling activities has been presented in Section 7.8 above. With excess concentrations of 5 mg/L and above predicted to occur less than 5% of the time, concentrations of 25 mg/L and above will be even more limited in duration, , rendering the impact insignificant.

Loss of Community and Habitat: During piling, loss of the macrobenthic community and its habitat is inevitable due to the invasive nature of the piling activity. Although this is the case, it is expected that this impact is temporary (only during piling) and will be confined along the piling and cofferdam areas only

Fish Fauna: The threshold limit for suspended sediment for fish health is based on Malaysia Marine Water Quality Criteria and Standard (MMWQCS) Class 2 categorizing fisheries as part of Class 2 with the limit of 50 mg/L TSS. The predicted suspended sediments from the piling activities is less than 5 mg/L, and hence no impacts on fish fauna is expected due to suspended sediment plumes. No suspended sediment plume impacts to the seagrass areas further south at Tg. Kupang are predicted. Consequently, the function of the seagrass bed as a nursery area for juvenile fish will not be affected.

Underwater Noise Disturbance: There is potential for fish fauna to be disturbed by noise and vibration as a result of piling, motors or heavy construction work on site as well as movement of vessels during construction. It is noted however that the foundation will be constructed with large-diameter bored cast in-situ piles. This minimises the impact by

avoiding high percussive sound emissions. According to McCauley (1994), the response of fish fauna to acoustic emissions can range from no effect to various behavioural changes. However, fish fauna are highly mobile and would generally avoid areas of high sound emissions. Impact will be during construction phase with low degree adverse impact and localized only within the working boundary.

7.11.2 Operational Phase

The principal Project's operations related activities that are capable of inducing environmental impacts include:

1. Footprint of piers
2. Repair and maintenance work on track

The potential impacts that could occur during the operational phase are assessed herewith.

7.11.2.1 Footprint of Piers

Fish Fauna: The presence of the piers may be beneficial to the fish fauna as these piers may possibly act as fish aggregating structures. This is especially significant for those piers located within deep waters.

7.11.2.2 Repair and Maintenance Work on Track

Fish Fauna: Potential impact to the water quality during the repair and maintenance work on track includes wastewater discharge and accidental spillage or leakage of chemicals and fuel / oil into the marine environment. Nevertheless, these spillages are predicted to be non-routine and minimal; the immediate impact on fish fauna would be migration of fish and free-swimming or mobile marine life to safer or less disturbed areas (generally deeper waters) as a natural response to changes in the marine environment thus avoiding direct deleterious effects.

7.12 LAND TRAFFIC

This sub-chapter describe land traffic impacts within surrounding existing road networks within ZOI of 2km radius of HSR alignment and facilities. More emphasis is placed on sensitive receptors surrounding the seven (7) traffic count stations and the HSR Stations. The assessment is based on the SIDRA generated status of Level of Service (LOS) which in essence, the assessment of traffic volumes versus the available capacity of the junction and road networks surrounding the intersection. The project activities as described in the Chapter 6. The impacts to be assessed will be based on current (baseline) LOS status at identified sensitive receptors surrounding the stations locations. Assessment of impacts for track works shall be described as a qualitative assessment for sensitive receptors (affected road networks) surrounding the whole entire track alignment.

The impacts assessment description shall be narrated by stages of HSR Project implementation and its locality of sensitive receptors from North (Bandar Malaysia Station) to South (Iskandar Puteri Station).

7.12.1 Pre-construction Phase

All Locations (along the entire HSR alignment)

During pre-construction phase, activities which will be carried out in sequence of least intrusive to most intrusive are land acquisition, land survey, utilities mapping, and utilities relocation. During the land survey, utilities mapping, and land acquisition, works can be well controlled and areas where the works are being carried out are not necessarily be required to be cordoned off instead, placement of equipment and workers are well within the boundary of the alignment and will impose minimal impact.

However, for the works to carry out utilities relocation which are the most intrusive at pre-construction phase, it is foreseen that this activity can potentially pose nominal impact due to sub-activities such as trenching and shoring works which leads to roads diversion/partial closure and construction of bypass route, construction of start and target shaft for pipe jacking or directional drilling works, movement of unsuitable materials to disposal areas, import of approved backfill material and transport of materials to offsite disposal area (**Figure 7-107**).

The utilities relocation activities which are anticipated to include relocation of water pipes, gas pipes, telecommunication lines, electrical lines, pylons, sewerage systems, and the like, will continue in the construction phase of the HSR Project.



Source: MyMRT website (<http://www.mymrt.com.my/>)

Figure 7-107: Conditions of Road Networks Surrounding Construction site During Utilities Relocation works

Hence, the magnitude of the impact anticipated to be minimal in regards to LOS status within the affected road network as additional vehicular traffic imposed by each of the activities is considered as insignificant and will have minimal low degree, short duration impact during this Pre-construction phase of the HSR Project.

7.12.2 Construction Phase

Introduction

During construction period expected to begin at 2020 and end at 2023, the activities involved are divided into two sections namely Track Work (At-Grade, Elevated, Tunnel and Bridges) section and Station / Depots / Maintenance Base section.

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The activities involved in the Track work will be Land Clearing, Demolition, Construction of Access Road, Earthwork, Drainage, Transportation of Materials / Equipment, Vehicle Movement, Traffic Diversion, Disposal of Unsuitable Materials, Waste / Wastewater Generation, Disposal of Solid and Construction Waste / Biomass, Piling, Construction of Elevated Structures / Bridges, Construction of At-Grade Structures, Tunnelling, Installation of Track, Employment of Workers and Staff, Business Development and Abandonment.

Whereas, the activities involved in the Station section are Land Clearing, Demolition, Construction of Access Road, Earthwork, Drainage, Transportation of Materials / Equipment, Vehicle Movement, Traffic Diversion, Disposal of Unsuitable Materials, Waste / Wastewater Generation, Disposal of Solid and Construction Waste / Biomass, Establishment of Site Office, Storage Areas, Establishment of Workers Camps, Piling, Construction of Station / Depots/ Maintenance Base, Construction of Elevated Structures / Bridges, Construction of At-Grade Structures, Utility Relocation, Employment of Workers and Staff, Business Development and Abandonment.

The above activities shall be taken into consideration in illustrating the impacts to the surrounding sensitive receptors during the construction phase.

A) FT. Kuala Lumpur

Introduction

The structure type proposed within FT. Kuala Lumpur alignment up to the Selangor state boundary will be Elevated Structure and Tunnel. The state crossing from FT. Kuala Lumpur and Selangor is within the Tunnel structure alignment specifically at the Palace of the Golden Horses vicinity under BESRAYA expressway (E39) alignment.

Bandar Malaysia Station and Tunnel

At Bandar Malaysia, the construction of the Bandar Malaysia Station, will involve several key activities which impose less number of trucks than the tunnelling works on the daily. Tunnel construction, impose the most significant impact throughout FT. Kuala Lumpur alignment as it involves boring works and disposal of unsuitable materials. Through FT. Kuala Lumpur alignment, construction of Tunnel 1 from the North Portal to the South Portal at Taman Sri

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Serdang will involve 85,000 trucks for the span of three years amounting to 91 trucks per day or 11 trucks per hour carrying the earth extracted from tunnel boring activities to be disposed of offsite at approved dumpsite. **Figure 7-100** shows example of a typical layout of tunnel construction with limited space requirement at Semantan Portal, Kuala Lumpur.

SIDRA analysis the LOS status at sampling point TKL1 is LOS A for year 2023 as shown in **Appendix 7J1**. LOS A indicates junction TKL1 where Jalan Lapangan Terbang Lama, Jalan Istana and Jalan Sg. Besi are the roads of concern, the junction and roads are able accommodate equivalent to 11 trucks per hour of the construction trucks that brings in materials for installation or assembly at the laydown area as well as workers from Centralised Labours Quarters (CLQ) with minimal, low degree, localised and short duration of impact throughout each day of the construction phase.



Source: MyMRT website (<http://www.mymrt.com.my/>) and MyHSR Corp

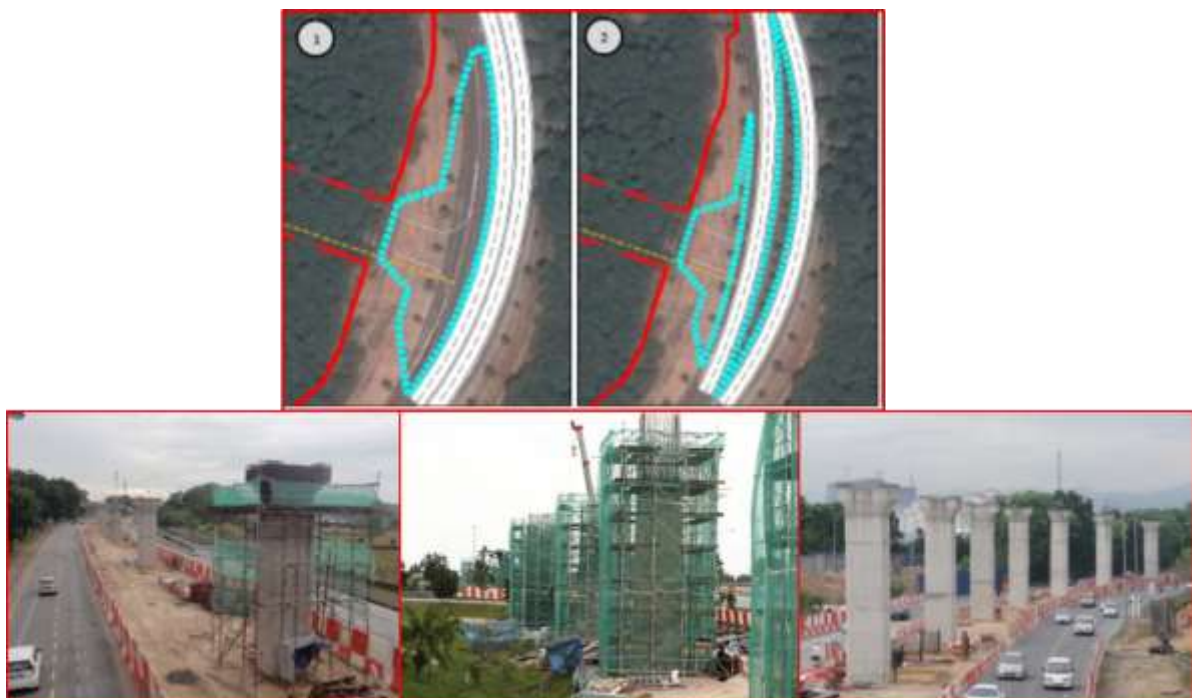
Figure 7-108: Kg. Baru Salak Selatan proposed North Portal Site and typical arrangement of equipment and Tunnel Face construction.

Both Tunnel portals, North portal and South portal are connected to major roadways namely BESRAYA (E39), North South Expressways (E2) and MRR2. Hence, it is anticipated that these road networks will be able to provide connectivity to areas to the north or south of both portals and cater for the additional traffic of 11 trucks per hour from the tunnel boring site to the offsite disposal area with minimal, localised, low degree impact to the LOS of the roads on concern.

The 11 trucks per hour movement out of the tunnelling works site is equivalent to only 1% of the total peak hour traffic forecasted for TKL1 junction which was recorded to have a peak hour traffic of 984 counts at present.

Elevated Structure

Impacts imposed during construction of the elevated structure within FT. Kuala Lumpur area is anticipated to impose minimal and localised impact to surrounding roads within the alignment path. With advancement and maturity of elevated structure construction methodologies, construction of the elevated tracks crossing over roads, rivers and properties, can be undertaken within a very constricted space with minimal traffic impacts to the ongoing traffic. The construction methodologies that will be adopted will be able to limit the intrusion into public roads that limits the reduction of the roads capacity and that will decrease the LOS status of the roads where the elevated structure crosses or runs parallel. Typical road diversion HSR Project is as illustrated in the following **Figure 7-109**.



Source: MyHSR Corp

Figure 7-109: Options for realignment of collector roads for construction of Elevated Structure within station area and at the roads median.

B) Selangor and FT. Putrajaya

Introduction

The structure type proposed within Selangor and FT. Putrajaya alignment up to the Negeri Sembilan state boundary will be Elevated Structure, Tunnel and At-Grade structure.

Sepang-Putrajaya Station and Tunnels

Construction of Sepang-Putrajaya Station and the 0.7 km mined tunnel at Puncak Pinggiran Putra, Kajang will impose additional traffic due to the tunnel mining activities. The number of construction trucks involved in constructing the 0.7 km mined tunnel from Puncak Pinggiran Putra, Kajang will be 25,380 trucks for the span of three (3) years amounting to 27 trucks per day or 3 trucks per hour will be carrying the soil mined from the tunnel activities to be dumped in the dedicated dumpsite.

From SIDRA analysis the LOS for sampling point TSP1 is at LOS F for year 2023 as shown in **Appendix 7J2**. LOS F indicates junction TSP1 cannot accommodate the forecast traffic flow including the construction trucks. This junction needs to be upgraded to handle the increase in traffic flow including the construction trucks.

The 3 trucks per hour movement out of this tunnelling works site is equivalent to only 0.1% of the total peak hour traffic forecasted for TSP1 junction which was recorded to have a peak hour traffic of 4,077 counts at present.

Similarly, the construction of another mined tunnel at Bukit Unggul Golf and Country Club, a 2.3 km mined tunnel, will add 7,420 trucks traffic over three (3) years duration, amounting to 8 trucks per day or 1 truck per hour, to carry the soil mined from the tunnel activities to be dumped at offsite approved dumpsite.

Based on SIDRA analysis the LOS for sampling point TSP1 is at LOS F for year 2023 as shown in **Appendix 7J3**. LOS F indicates junction TSP1 cannot accommodate the forecast traffic flow including the construction trucks. This junction needs to be upgraded to handle the increase in traffic flow including the construction trucks.

The one truck per hour movement out of this tunnelling works site is equivalent to only 0.03% of the total peak hour traffic forecasted for TSP1 junction which was recorded to have a peak hour traffic of 4,077 counts at present.

Elevated Structure

Impacts imposed during construction of the Elevated Structure within Selangor - FT. Putrajaya area is anticipated to impose minimal and localised impact to surrounding roads within the HSR alignment. With advancement and maturity of elevated structure construction methodologies, as can be observed in all linear elevated rail and road projects in Malaysia, construction of the elevated tracks crossing over roads, rivers and properties, can be undertaken within a very constricted space with minimal traffic impacts to the ongoing traffic. The construction methodologies that will be adopted will be able to limit the intrusion into public roads that limits the reduction of the roads capacity and that will decrease the LOS status of the roads where the elevated structure crosses or runs parallel.

At-grade Structure

Within Selangor - FT. Putrajaya alignment, five (5) short stretches of At-Grade structure is anticipated. For At-Grade alignment, construction works will be planned to include areas required for traffic diversion only if it is necessary hence impacts to surrounding traffic is expected to be minimal, short duration and to the LOS, will have low degree impact to surrounding networks traffic. Typical area requirement for the construction of At-Grade structures are illustrated in the following **Figure 7-110**.



Source: MyHSR Corp

Figure 7-110: Typical construction areas requirement for at-grade construction within constricted working limits.

C) Negeri Sembilan

Seremban Station and Tunnels

During construction period the number of construction trucks involve in constructing a 0.4 km mined tunnel from Kg. Baharu Jimah to Bandar Springhill as well as the Seremban Station, it is expected that there will be 4,720 trucks movement within the span of three (3) years amounting to 5 trucks per day or one truck per hour will be carrying the soil mined from the tunnel activities as well as earthworks at the Seremban Station to be dumped offsite at an approved dumpsite. From SIDRA analysis the LOS for sampling point TNS1 is at LOS F for year 2023 as shown in **Appendix 7J4**. LOS F indicates junction TNS1 cannot accommodate the forecast traffic flow including the construction trucks. This junction needs to be upgraded to handle the increase in traffic flow including the construction trucks.

Similarly, during the construction of another 0.4 km mined tunnel from Bandar Springhill to Ladang Salak, Sime Darby Plantation the number of construction trucks involve in constructing this tunnel will be 4,560 trucks for the span of three (3) years amounting to 5 trucks per day or 1 truck per hour will be used to carry the soil mined from the tunnel activities to be transported and disposed at an approved dumpsite.

From SIDRA analysis the LOS for sampling point TNS1 is at LOS F for year 2023 as shown in **Appendix 7J5**. LOS F indicates junction TNS1 cannot accommodate the forecast traffic flow including the construction trucks. This junction needs to be upgraded to handle the increase in traffic flow including the construction trucks.

The 5 trucks per hour movement out of this tunnelling works site is equivalent to only 0.3% of the total peak hour traffic forecasted for TNS1 junction which was recorded to have a peak hour traffic of 1,521 counts at present.

Elevated Structure

Impacts imposed during construction of the elevated structure within Negeri Sembilan alignment is anticipated to impose minimal and localised impact to surrounding roads within the HSR alignment. With advancement and maturity of elevated structure construction methodologies, as can be observed in all linear elevated rail and road projects in Malaysia, construction of the elevated tracks crossing over roads, rivers and properties, can be undertaken within a very constricted space with minimal traffic impacts to the ongoing traffic. The construction methodologies that will be adopted will be able to limit the intrusion into public roads that limits the reduction of the roads capacity and will decrease the LOS status of the roads where the elevated structure crosses or runs parallel.

At-grade Structure

Within Negeri Sembilan alignment, majority of the tracks structure type are of At-Grade alignment. For At-Grade alignment, construction works will be planned to include areas required for traffic diversion only if it is necessary hence impacts to surrounding traffic is expected to be minimal, short duration and to the LOS, will have low degree impact to surrounding networks traffic.

D) Melaka

Melaka Station

During construction, it is anticipated that construction of Melaka Station will impose higher than normal volumes of traffic. However, the degree of additional traffic imposed is expected

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to be insignificant (estimated at less than 1 truck per hour movement on average throughout the 3 years construction period) as compared to the existing traffic surrounding traffic counting station TM1 throughout the construction period. From SIDRA analysis, the LOS for sampling point TM1 is at LOS F for the year 2023. LOS F indicates junction TM1 should be upgraded to accommodate the huge increase in traffic flow which the intersection of concern along with its surrounding roads are not able to accommodate the additional traffic.

Elevated Structure

Impacts imposed during construction of the elevated structure within Melaka alignment is anticipated to impose minimal and localised impact to surrounding roads within the HSR alignment. With advancement and maturity of elevated structure construction methodologies, as can be observed in all linear elevated rail and road projects in Malaysia, construction of the elevated tracks crossing over roads, rivers and properties, can be undertaken within a very constricted space with minimal traffic impacts to the ongoing traffic. The construction methodologies that will be adopted will be able to limit the intrusion into public roads that limits the reduction of the roads capacity and will decrease the LOS status of the roads where the elevated structure crosses or runs parallel.

At-Grade Structure

Within Melaka state alignment too, majority of the tracks structure type are of At-Grade alignment. For At-Grade alignment, construction works will be planned to include areas required for traffic diversion only if it is necessary, hence impacts to surrounding traffic is expected to be minimal, short duration and to the LOS, will have low degree impact to surrounding networks traffic.

E) Johor

Muar, Batu Pahat and Iskandar Puteri Stations and Tunnels

From SIDRA analysis the LOS for sampling point TJ1 is at LOS F for year 2023 as shown in **Appendix 7J6**. LOS F indicates junction TJ1 cannot accommodate the forecast traffic flow including the construction trucks. The construction of Muar Station involves minimal (estimated at less than 2 truck movement per hour throughout the three (3) years

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construction period) increase of traffic volume and since the junction is at LOS F now, it is anticipated that the junction would need to be upgraded to handle the increase in traffic flow including the construction trucks.

At TJ2, SIDRA analysis shows that the junction is at LOS F in 2017 and in 2023, during and up to the end of the construction phase, it is anticipated to remain at LOS F considering no permanent capacity expansion of the junction. The Batu Pahat Station construction involve also minimal increase in traffic volume per day hour (estimated at 2 trucks per hour) however, since the LOS is at already limiting LOS F, it is expected that the junction capacity need to be increased.

Areas surrounding Iskandar Puteri Station, surrounding areas of TJ3, through SIDRA analysis of current baseline information on traffic volume and roads capacity, it is still at LOS F which limits movement of trucks at peak hours. Even though it is expected that additional traffic imposed for the station construction will not be significant (estimated to be less than 2 trucks per hour movement on average throughout the three (3) years construction period), the limitation is still the current LOS F.

There are also several tunnels that is to be constructed along the Johor HSR alignment namely the Bukit Naning 1 and Bukit Naning 2 Tunnel.

During construction phase of these tunnels, the number of construction trucks involve in the construction 16,275 trucks over the span of three (3) years amounting to 16 trucks per day or 2 trucks per hour. Two tunnels with total length of 2.3 km, which will be a mined tunnel at Bukit Naning, Muar, will involve transporting the soil mined from the tunnel activities to be dumped at an approved offsite dumpsite.

From SIDRA analysis the LOS for sampling point TJ1 is at LOS F for year 2023 as shown in **Appendix 7J7**. LOS F indicates junction TJ1 cannot accommodate the forecast traffic flow including the construction trucks. This junction needs to be upgraded to handle the increase in traffic flow including the construction trucks.

The 2 trucks per hour movement out of this tunnelling works site is equivalent to only 0.3% of the total peak hour traffic forecasted for TJ1 junction which was recorded to have a peak hour traffic of 1,521 counts at present.

Elevated Structure

In Johor, the stretches of elevated structure and At-Grade tracks are balanced from the Melaka – Johor state border to the MY-SG International Border. Impacts imposed during construction of the elevated structure within Johor alignment is anticipated to impose minimal and localised impact to surrounding roads within the HSR alignment. With advancement and maturity of elevated structure construction methodologies, as can be observed in all linear cross state projects in Malaysia, construction of the elevated tracks crossing over roads, rivers and properties, can be undertaken within a very constricted space with minimal traffic impacts to the ongoing traffic. This will enable the project activities to be done with minimal intrusion into public roads that limits the reduction of the roads capacity and will decrease the LOS status of the roads where the Elevated Structure crosses or runs parallel.

At-Grade Structure

Within Johor alignment, there are several tracks stretches structure type are of At -Grade alignment. For At-Grade alignment, construction works will be planned to include areas required for traffic diversion only if it is necessary, hence impacts to surrounding traffic is expected to be minimal, short duration and to the LOS, will have low degree impact to surrounding networks traffic.

7.12.3 Land Traffic Impact during Operation

A) FT. Kuala Lumpur

During operation the annual ridership forecast for the year 2030 and 2060 will be 5,134,000 persons/year and 12,959,000 persons/year respectively. If half (50%) (based on assumption and experience elsewhere) of the total ridership will travel by roads and the rest by others train-based mode of transport there will be an increase in road traffic flow to and from the elevated Bandar Malaysia Station especially during the morning and evening peak hours. This scenario should be addressed accordingly.

From SIDRA analysis the LOS for sampling point TKL1 are both at LOS F for the year 2030 and 2060 as shown in **Appendix 7L1** and **7L2** respectively. The LOS F indicates junction TKL1 should be upgraded to accommodate the enormous increase in traffic flow which it cannot sustain.

Bandar Malaysia Station and surrounding area will experience chaotic scenarios in term of movement of road traffic and pedestrian if the ingress and egress routes to the station is not well planned, designed and constructed in regards to of number of lanes per direction to accommodate the increase in traffic flow. If derailment or collision occurred, some chaotic scenarios at the station and its vicinity are expected.

B) Selangor and FT. Putrajaya

The Sepang-Putrajaya Station shall be connected by roads from Jalan P14 and Jalan Ayer Hitam. The proposed Station is approximately 3.5 km east of the Putrajaya Administrative Centre and 2.8 km west of Bandar Baru Bangi. The location is of close proximity to numerous Institutional Training Centres, and borders the residential area of Kg. Dato Abu Bakar Baginda and the Diplomatic Precint in Putrajaya.

During operation the annual ridership forecast for the year 2030 and 2060 will be 371,000 persons/year and 842,000 persons/year respectively. If all of the total ridership will travel by roads there will be an increase in road traffic flow to and from the elevated Sepang-Putrajaya Station especially during the morning and evening peak hours. These untoward scenarios should be addressed accordingly.

From SIDRA analysis, the LOS for sampling point TSP1 are both at LOSs F for the year 2030 and 2060 as shown in **Appendix 7L3** and **7L4** respectively. The LOS F indicates junction TSP1 should be upgraded to accommodate huge increase in traffic flow which it cannot endure. During operation for the Light Depot and Light Maintenance Base at Serdang, the annual ridership forecast for staff or workers for the 2030 will be 600 persons/year. There will be minimum movement of road traffic at this facility in Serdang.

C) Negeri Sembilan

Seremban Station will be an integral part of the Integrated Transport District (ITD), one of the six (6) economic clusters planned in MVV through its draft CDP, making it a strategic location for several growth areas. Bio-economy is one key growth area as there is already existing infrastructure and plans to promote a life sciences cluster technology park in MVV.

During operation the annual ridership forecast for the year 2030 and 2060 will be 1,907,000 persons/year and 4,927,000 persons/year respectively. If all of the total ridership will travel by roads there will be a big increase in road traffic flow to and from the At-Grade Seremban Station especially during the morning and evening peak hours. These inconvenient scenarios should be addressed accordingly.

From SIDRA analysis, the LOS for sampling point TNS1 are both at LOSs F for the year 2030 and 2060 as shown in **Appendix 7L5** and **7L6** respectively. LOS F indicates junction TNS1 should be upgraded to accommodate the huge increase in traffic flow which it cannot cope. Movement of train is expected to be smooth, punctual and on time to indicate professional and excellent services.

D) Melaka

The Melaka Station is envisaged to be connected by roads from Lebuhraya SPA, Lebuhraya Ayer Keroh and Jalan Durian Tunggal. The Station is located approximately 0.6 km south from the North-South Highway Ayer Keroh Toll Plaza and 12 km northeast of the historical city of Melaka. The Melaka International Trade Centre is located 3.5 km southwest of the Station. The land profile is undulating and the preferred access to the Station is from Lebuhraya SPA.

During operation the annual ridership forecast for the year 2030 and 2060 will be 1,540,000 persons/year and 3,850,000 persons/year respectively. If all of the total ridership will travel by roads there will be a big increase in road traffic flow to and from the elevated Melaka Station especially during the morning and evening peak hours. These troublesome scenarios should be addressed accordingly. From SIDRA analysis, the LOS for sampling point TM1 are both at LOSs F for the year 2030 and 2060 as shown in **Appendix 7L7** and **7L8** respectively. LOS F indicates junction TM1 should be upgraded to accommodate the huge

increase in traffic flow which it cannot handle. Movement of train is expected to be smooth, punctual and on time to indicate professional and excellent services.

Melaka Station will experience chaotic scenarios in term of movement of road traffic and pedestrian if it is not well designed and constructed to address their present. When derailment or collision occurred, some chaotic scenarios will be expected.

E) Johor

Muar Station

Muar station will be located within the Pagoh High Education Hub nearby Muar town. In addition to supporting the student population, the HSR Station will provide new connectivity and market access to its tourism and furniture industries. Muar has a distinct identity as Bandar Maharani Bandar Di Raja (Royal City of Johor) and is being positioned as the foundation of the 'Cradle of Johor Heritage'. This will be a unique tourist draw that will facilitate the development of this area.

During operation the annual ridership forecast for the year 2030 and 2060 will be 592,000 persons/year and 1,494,000 persons/year respectively. If all of the total ridership will travel by roads there will be a big increase in road traffic flow to and from the elevated Muar Station especially during the morning and evening peak hours. These bothersome scenarios should be addressed accordingly. From SIDRA analysis, the LOS for sampling point TJ1 are both at LOSs F for the year 2030 and 2060 as shown in **Appendix 7L9** and **7L10** respectively. LOS F indicates junction TM1 should be upgraded to accommodate the huge increase in traffic flow which it cannot handle. During operation there will be an increase in road traffic flow and pedestrians movement at this station especially during morning and evening peak hours.

During operation for the Heavy Maintenance Base at Muar depot, the annual ridership forecast for staff or workers for the 2030 will be 600 persons/year. There will be minimum movement of road traffic at the Heavy Maintenance Base.

Areas within the vicinity of Muar Station will experience chaotic scenarios in term of movement of road traffic and pedestrian if they are not well designed and constructed to address their present. When derailment or collision occurred, some chaotic scenarios will be expected.

Batu Pahat Station

Batu Pahat Station is located within the masterplan of a new residential development of Pura Kencana. The proposed station shall be accessed from Jalan Kluang. The Station is located approximately 6.5km west of Universiti Tun Hussein Onn and 9 km east of Batu Pahat.

During operation the annual ridership forecast for the year 2030 and 2060 will be 888,000 persons/year and 2,225,000 persons/year respectively. If all of the total ridership will travel by roads there will be a big increase in road traffic flow to and from the elevated Batu Pahat Station especially during the morning and evening peak hours. These annoying scenarios should be addressed accordingly.

From SIDRA analysis, the LOS for sampling point TJ2 are both at LOSs F for the year 2030 and 2060 as shown in **Appendix 7L11** and **7L12** respectively. LOS F indicates junction TM1 should be upgraded to accommodate the huge increase in traffic flow which this junction are unable to accommodate.

During operation there will be an increase in road traffic flow and pedestrians movement at this stations especially during morning and evening peak hours.

Iskandar Puteri Station

Iskandar Puteri Station is the last Station within Peninsular Malaysia and will serve both the domestic (MY only) and international (from SG) passengers, CIQ facilities will be provided in this Station. It is located in Iskandar Malaysia, a special economic region established by the government of Malaysia.

During operation the annual ridership forecast for the year 2030 and 2060 will be 1,165,000 persons/year and 2,939,000 persons/year respectively. If all of the total ridership will travel

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by roads there will be a big increase in road traffic flow to and from the Iskandar Puteri Station especially during the morning and evening peak hours.

From SIDRA analysis, the LOS for sampling point TJ3 are both at LOSs F for the year 2030 and 2060 as shown in **Appendix 7L13** and **7L14** respectively. LOS F indicates junction TJ3 should be upgraded to accommodate the huge increase in traffic flow.

During operation there will be an increase in road traffic flow and pedestrians movement at these Stations especially during morning and evening peak hours. There will be minimal (estimated at less than 10 traffic movement per hour on average) to the additional road traffic surrounding of the Main Depot and Light Maintenance Base.

Iskandar Puteri At-Grade Station will experience chaotic scenarios in term of movement of road traffic and pedestrian if they are not well designed and constructed to address their present conditions. When derailment or collision occurred, some chaotic scenarios will be expected.

7.13 MARINE TRAFFIC

7.13.1 Construction Phase

The principal construction related activities that are capable of inducing environmental impacts include:

1. Transportation of materials and equipment by Barges
2. Disposal of solid and construction water/biomass
3. Piling Works
4. Construction of elevated structures/bridges

The potential impacts that could occur during the construction phase are assessed herewith.

7.13.1.1 Transportation of Materials and Equipment by Barges

The construction of the bridge with the 36 piers and the placement or construction of beams between piers would require substantial support and transportation base from the shore. The on-land support base for the construction activities will provide facilities for loading and unloading of equipment, material as well as personnel required for the bridge construction. These activities would be continuous during the construction period that may take more than two (2) years. However, the location of this support base is as yet unknown. For the purposes of this assessment, it is assumed that it is within 5 km of the HSR Project footprint.

The vessels that would be making more frequent movements would be the passenger launches and tugs and would be moving from the support base to the piling sites and other locations. The barges movements would be less frequent and generally would be moving during high water and when the loading or unloading has been completed. Therefore, an increased volume of marine traffic is expected during the marine construction involving activities during construction of piers to deliver construction material, pile barge etc. With the assumption that the support base is located within 5 km of the project site, a localised, low degree adverse impact is expected.

7.13.1.2 Piling Works

An increase in volume of marine traffic is expected during the piling activities. There will also be potential of vessel collision among the working vessels and also the fishing vessels. Small boats may be damaged or sunk by a collision with larger vessel. However it is predicted that potential impacts will only occur for a short duration and will be low key and localized only within the working boundary.

7.13.1.3 Construction of Elevated Structures/Bridges

The construction of the Elevated Structures and Bridges may necessitate the closure of a particular section of the HSR Bridge between piers, however detailed information is not available at the moment. The closure of that particular section should be coordinated with the Marine Department Wilayah Selatan for the issuance of the Notice to Mariners and Port Notice. If the main channel is to be reduced in vertical clearance or be closed due to construction activities, the project proponent should consult with the Marine Department Wilayah Selatan on the ways how to reduce the risk to shipping during the temporary vertical limits reduction or closure. Only with the Marine Department Wilayah Selatan agreement may the main channel be temporarily reduced in its vertical limits or be temporarily closed.

Based on the design of construction methods, the incorporation of International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) requirements, and the temporary nature of the works, it is anticipated that there will be a low negative effect on users of the Tebrau Strait due to the presence of temporary structures within the channel. Based on the importance of the receptor (moderate) and the magnitude of effect (low) it is considered that the significance of this effect will be low. Impact will be during Construction Phase with low degree adverse impact and localized only within the working boundary.

7.13.2 Operational Phase

The principal Project's operations related activities that are capable of inducing environmental impacts include:

1. Footprint of piers
2. Repair and maintenance work on track

The potential impacts that could occur during the operational phase are assessed herewith.

7.13.2.1 Footprint of Piers

The HSR bridge will maintain the same vertical clearances as currently available to navigational craft at the Second Link Bridge. As it is located around 500 m west of the Second Link Bridge, its vertical clearance using the tidal datum for the Port of Tanjung Pelepas has also been calculated. Based on this information the proposed vertical for HSR Bridge will be as follows:

- West Channel vertical clearance: 9 m above MHWS; and
- Main Channel vertical clearance: 25 m above MHWS and
- Horizontal width of 75 m

It is therefore considered that there will be no effect on users of the Tebrau Strait due to the operation of the HSR Project in terms of air draft clearance.

7.13.2.2 Repair and Maintenance Work on Track

Marine Navigation: During regular maintenance of the HSR bridge, structure there will be a temporary reduction in vertical clearance due to the requirement for temporary structures beneath the final soffit level. This will be short term and temporary in nature and of low magnitude. Based on the importance of the receptor (moderate) and the magnitude of this effect (low) it is therefore considered that there will be a low significant effect for users of the Tebrau Strait due to maintenance activity. Impact will be limited only during repair and maintenance work with low degree adverse impact and localized only within the working boundary.

7.14 VISUAL IMPACT

The assessment of the impacts of the HSR Project to the visual quality and sensitivity of each landscape characters will focus on the visual zone of impact which is within 500 m corridor (250 m from centre line) of the HSR alignment. However, consideration will be given to the visual zone outside of 500 m zone of impacts if there are significant views or vistas. The assessment of visual impacts is at two level; general impacts and detail impacts.

- a) *General visual impacts assessment* – to assess the visual impacts to the landscape characters based on the matrix analysis of visual quality and visual sensitivity levels if any development to occur
- b) *Detail visual impacts assessment* - to assess the detail visual impacts of HSR Project to the landscape characters based on general visual impacts analysis results

7.14.1 General Impacts Assessment

In order to examine potential impact of Project to the existing landscape visual quality within 500 m zone of impact, Visual Quality (VQA) and Visual Sensitivity (VSA) level of each landscape character segments were overlapped and analyzed by using visual matrix (**Table 7-41**). The matrix table would categorize the landscape characters segments into high, moderate and low visual impacts.

Table 7-41: Visual Impact Matrix

| VS \ VQ | Low | Moderately Low | Moderate | Moderately High | High |
|-----------------|----------|----------------|----------|-----------------|----------|
| Low | Low | Low | Low | Moderate | Moderate |
| Moderately Low | Low | Low | Low | Moderate | Moderate |
| Moderate | Low | Low | Moderate | High | High |
| Moderately High | Moderate | Moderate | High | High | High |
| High | Moderate | Moderate | High | High | High |

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- a) Low impact – development will not change the visual quality and sensitivity of the landscape characters
- b) Moderate impact – development will moderately change the visual quality and sensitivity of the landscape characters
- c) High impact – development will change the visual quality and sensitivity of the landscape characters

A) F.T Kuala Lumpur

Based on matrix analysis, from 41 landscape characters, 21 landscape characters segments were categorised as having low impacts (51.2 %), 15 segments (36.6 %) are having moderate impacts and five (5) segments (12.2 %) are having high impacts (**Table 7-42**).

Table 7-42: General Visual Impact for the FT. Kuala Lumpur

| General Visual Impacts | Total LC Segments | Nos | Percentage (%) |
|------------------------|-------------------|-----|----------------|
| Low | 41 | 21 | 51.2 |
| Moderate | | 15 | 36.6 |
| High | | 5 | 12.2 |

The areas that have been identified for having high visual impacts are hilly lakesides areas near Terminal Bersepadu Selatan at Bandar Tasik Selatan and Lakeside Residence at Bandar Tasik Selatan. These areas are considered to have high impacts due to the facts that they are located on hilly site, presence of water bodies and highly visible to the viewers. It is observed that the areas marked for Bandar Malaysia Station are classified as having low and moderate visual impacts. Please refer to **Appendix 7M – Table 1** and **Appendix 7O1** for detail distribution of the general visual impacts areas in the FT. Kuala Lumpur

B) F.T Putrajaya

There are two (2) landscape characters segments within HSR Project corridor in the FT. Putrajaya. It was found that one segment (50 %) were classified as having low visual impacts and the other one is having moderate (50 %) visual impacts (**Table 7-43**). Please refer to **Appendix 7M – Table 2** and **Appendix 7O2** for detail distribution of the general visual impacts areas in FT. Putrajaya.

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Table 7-43: General Visual Impact for FT. Putrajaya

| General Visual Impacts | Total LC Segments | Nos | Percentage (%) |
|------------------------|-------------------|-----|----------------|
| Low | 2 | 1 | 50 |
| Moderate | | 1 | 50 |
| High | | 0 | 0 |

C) Selangor

From 64 landscape characters segments within HSR Project corridor in Selangor and based on matrix analysis, it was found that 27 segments (42.2 %) were classified as having low visual impacts, 15 segments (23.4 %) are classified as having moderate visual impacts and 22 segments (34.4 %) are classified as having high visual impacts. (**Table 7-44**).

Table 7-44: General Visual Impact for Selangor

| General Visual Impacts | Total LC Segments | Nos | Percentage (%) |
|------------------------|-------------------|-----|----------------|
| Low | 64 | 27 | 42.2 |
| Moderate | | 15 | 23.4 |
| High | | 22 | 34.4 |

Areas that have been identified to have high visual impacts are lakeside areas near the Mines Resort, institutional landscapes of UPM at Faculty Engineering and Faculty of Design and Architecture, UPM as well as the hilly pastoral landscape. In addition, these areas also found to have high visual impacts; Country Height, institutional landscape of UNITEN and Maybank Training Center, hilly landscape near Jenderam and and Salak Tinggi. These areas are having high visual impacts because they are unique in character and highly visible from the road. It is noted that the majority of the areas marked for Light Depot and Light Maintenance Base in Serdang are classified as having high and moderate visual impacts. Meanwhile, areas designated for Sepang-Putrajaya Station is classified as having moderate impact. Please refer to **Appendix 7M – Table 3** and **Appendix 7O3** for detail distribution of the general visual impacts areas in the state of Selangor.

D) Negeri Sembilan

From 28 landscape characters segments within HSR Project corridor in Negeri Sembilan and based on matrix analysis, it was found that 11 segments (39.3%) were classified as having low visual impacts, 11 segments (39.3%) are classified as having moderate visual impacts and six (6) segments (16.9%) are having high visual impacts. (**Table 7-45**).

Table 7-45: General Visual Impact for Negeri Sembilan

| General Visual Impacts | Total LC Segments | Nos | Percentage (%) |
|------------------------|-------------------|-----|----------------|
| Low | 28 | 11 | 39.3 |
| Moderate | | 11 | 39.3 |
| High | | 6 | 21.4 |

Areas that have been found to have high visual impacts are residential and recreational areas near Kota Seriemas. The areas have highly organised landscape, high end residential and opportunity for recreation. It is noted that the areas marked for Seremban Station are classified as having low visual impacts. Please refer to **Appendix 7M – Table 4** and **Appendix 7O4** for detail distribution of the general visual impacts areas in Negeri Sembilan.

E) Melaka

From 41 landscape characters segments within HSR Project corridor in Melaka and based on matrix analysis, it was found that 20 segments (48.8 %) were classified as having low visual impacts, 15 segments (36.6 %) are classified as having moderate visual impacts and six (6) segments (14.6 %) are having high visual impacts. (**Table 7-46**).

Table 7-46: General Visual Impact for Melaka

| General Visual Impacts | Total LC Segments | Nos | Percentage (%) |
|------------------------|-------------------|-----|----------------|
| Low | 41 | 20 | 48.8 |
| Moderate | | 15 | 36.6 |
| High | | 6 | 14.6 |

Areas that have been found to have high visual impacts in Melaka is traditional village at Kg Solok Ayer Limau, riparian landscape of Sg. Melaka at Krubong near Kg. Pulau, and areas near to PLUS interchanges at Ayer Keroh. These areas are having high visual impacts

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because they are unique in character (traditional architecture), highly visible from the road and tourism point of view and the presence of large water bodies (Sg Melaka). It is observed that the areas marked for Melaka Station at Ayer Keroh are classified from low to high impacts but majority of the impacts are moderate in nature. Please refer to **Appendix 7 M – Table 5** and **Appendix 7O5** for detail distribution of the general visual impacts areas in Melaka

F) Johor

There are 84 landscape characters segments within HSR Project corridor in Johor. From these 84 segments it was found that 47 segments (56.0%) are classified as having low visual impacts, 33 segments (39.3%) are having moderate visual impacts and four (4) segments (4.8%) are having high visual impact level (**Table 7-47**). Areas that have been found to have high visual impacts are traditional village near Pagoh around Kg. Selancar and Kg. Raja, school and residential areas near Simpang Renggam, swamp forest near aquaculture center at Gelang Patah and swamp forest as well as estuarine landscape near Kg. Ladang and Tebrau Strait. They are three (3) stations in Johor; Muar, Batu Pahat and Iskandar Puteri and it is observed that for these three (3) stations, the visual impacts levels are classified as moderate and low. For HMB in Muar and Main Depot and LMB in Pontian the visual impacts are classified as low and moderate. Please refer to **Appendix 7M – Table 6** and **Appendix 7O6** for detail distribution of the general visual impacts in the state of Johor.

Table 7-47: General Visual Impact for Johor

| General Visual Impacts | Total LC Segments | Nos | Percentage (%) |
|------------------------|-------------------|-----|----------------|
| Low | 84 | 47 | 56.0 |
| Moderate | | 33 | 39.3 |
| High | | 4 | 4.8 |

The general visual impacts of HSR Project to the existing visual quality were identified within 500 m zone of impacts and the impacts were classified into 3 levels; high, moderate and low. **Table 7-48** summarizes the impacts for the entire expanse of HSR Project from the FT. Kuala Lumpur to Johor.

Table 7-48: Summary of Visual Impacts for HSR Project

| Visual Impacts Classification | No of Landscape Character Segments | No | Percentage (%) |
|-------------------------------|------------------------------------|-----|----------------|
| Low | 260 | 127 | 48.8 |
| Moderate | | 90 | 34.6 |
| High | | 43 | 16.5 |

Majority of the impacts are low in nature (48.8%) but nevertheless all the impacts must be mitigated according to certain measures or strategies. However, before the detail mitigation measures can be suggested, the detail visual impacts assessment must be carried out to identify which landscape characters segments or areas that need to be visually mitigated.

7.14.2 Detail Impacts Assessment

For the detail visual impacts assessment, the HSR alignments was overlapped with HSR visual impacts map and the impacts were observed and analyzed. The factors that need to be examined during the detail impact assessment are the changes to the landscape characters visual quality due to the:

- the presences of HSR structures* – refer to the location or alignment of HSR structures within the 500 m zone of impacts
- construction on of the types of structures* – refer to the type of structures to be built along the HSR Project corridor includes station, depot, maintenance base, tunnel, elevated structure and At-Grade track

The outputs of the details visual impacts assessment were classified into 3 types; minor adverse, adverse and major adverse. It is proposed that if the HSR alignment or structures are overlapped with general high impact zone, the detail impact will be major adverse and consequently if the alignments and structures are overlapped with general moderate impact zone, the detail impact will be adverse. Last, if the HSR alignment and structures were overlapped with the general low impact zone, the detail impact will be minor adverse (**Table 7-49**). Therefore, it is also noted that some of the landscape character within zone of impact will not be affected at all by the development (no contact with HSR structures) and these areas will be classified as having none applicable or no impacts.

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Table 7-49: Relationship between General Visual Impacts and Detail Visual Impact

| General Visual Impacts | Detail Visual Impacts | Description of Detail Visual Impacts |
|------------------------|-----------------------|--|
| Not applicable | No impact | No changes to the landscape character of the development (no contact with HSR structures). |
| Low | Minor adverse | Minor changes to the landscape character of the development areas causing minimal decrease in visual quality due to the presence of HSR alignment |
| Moderate | Adverse | Noticeable changes to the landscape character of the of development areas causing noticeable decrease in visual quality due to the presence of HSR alignment |
| High | Major adverse | Total changes to the landscape character of the development areas causing substantial decrease in visual quality due to the presence of HSR alignment |

Upon the completion of detail impacts analysis, the detail impacts will be examined for their temporal dimension and extent of impacts. For the temporal dimension, the impacts were evaluated either the changes will be reversible or irreversible. Meanwhile for extent of impacts, the evaluation considered either the detail impacts will have the influence at the site, local, regional or national levels.

A) F.T Kuala Lumpur

There are 41 landscape characters segments within HSR Project corridor in the FT. Kuala Lumpur but only 22 segments are overlapped with HSR structures. None of the segment is categorized as having major adverse impacts (**Table 7-50**) whilst 5 segments (12.2%) will have adverse impact and three (3) (7.3%) will have minor adverse impact. This is due to the facts that, HSR Project, in many part in the FT. Kuala Lumpur would be built underground by using tunnel system causing less impact to the visual quality. Nevertheless, areas marked for Bandar Malaysia Station need to be carefully analysed for the mitigation measures because it is a terminal point for HSR Project and important gateway to the FT. Kuala Lumpur as well as Malaysia. For detail tabulation of assessment for the FT. of Kuala Lumpur, (**Appendix 7N – Table 1**)

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Table 7-50: Detail Visual Impacts for FT. Kuala Lumpur

| Detail Visual Impacts | Nos of Landscape Characters | Percentage |
|---|-----------------------------|------------|
| No impact (no contact with HSR structures) | 33 | 80.5 |
| Minor adverse | 3 | 7.3 |
| Adverse | 5 | 12.2 |
| Major adverse | - | 0 |

B) F.T Putrajaya

There are two (2) landscape characters segments within HSR Project corridor in the FT. Putrajaya and these two (2) segments were found not overlapped with any HSR Project structure (**Table 7-51**). Even though the lands are within the visual zone of impacts due to the Sepang-Putrajaya Station nearby no detail impact is recorded because the station will be built on Selangor sides and no segment is categorized as having major adverse impacts. For detail tabulation of assessment for the FT. Putrajaya, please refer to **Appendix 7N – Table 2)**

Table 7-51: Detail Visual Impacts for FT. Putrajaya

| Detail Visual Impacts | Nos of Landscape Characters | Percentage (%) |
|---|-----------------------------|----------------|
| No impact (no contact with HSR structures) | 2 | 100 |
| Minor adverse | - | - |
| Adverse | - | - |
| Major adverse | - | - |

C) Selangor

There are 64 landscape characters segments within HSR Project corridor in Selangor and 30 of the segments will be overlapped directly with HSR structures. Detailed tabulation of assessment for Selangor can be seen in **Appendix 7N – Table 3**. Of these 30 segments, 12 segments (18.8%) are categorized as having major adverse impacts (**Table 7-52**).

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Table 7-52: Detail Visual Impacts for Selangor

| Detail Visual Impacts | Nos of Landscape Characters | Percentage (%) |
|---|-----------------------------|----------------|
| No impact (no contact with HSR structures) | 34 | 53.1 |
| Minor adverse | 11 | 17.2 |
| Adverse | 7 | 10.9 |
| Major adverse | 12 | 18.8 |

These 12 areas that were categorized as having major adverse impacts can be grouped into these major areas;

- a) *UPM, Serdang pastoral* (segment no: 18, 20, 23, 24, 26, 27) – this pastoral area is undulating landscapes and has long become the unique features for UPM, Serdang as well as nation. It provides scenic landscape along PLUS highway and backdrop for the high end residential areas of Country Height. The HSR structures proposed to be built are Light Depot and LMB including elevated structure and At-Grade alignment. The visual impacts will irreversible and the pastoral landscape characters of these areas will be permanently changed.
- b) *UNITEN, Bangi campus areas* (segment no: 38, 39) - this area houses several buildings which have unique architecture includes UNITEN admin building, Masjid UNITEN, Maybank Training Center, Institut Kemajuan Desa and Institut Latihan Petronas. In addition, ILSAS golf course also located in this area. The HSR structures for this area will be elevated structure and the elevated structure will cause the visual integration of the surrounding structures and landscapes disintegrate. The visual impacts will be irreversible and the institutional; landscape characters of these areas will be permanently changed.
- c) *Sepang natural hilly forested areas* (segment no: 51, 53, 55, 56) - this area stretches from Kg. Sg. Merab to Bukit Unggul near Jenderam. The area is hilly with natural green characters and Sg. Langat provide valley in between the hilly landscapes. The HSR structures for this area will be elevated structure in which the elevated structure will traverse through this natural hilly and valley landscapes. The visual impacts are possibly be reversed even though the landscape characters of these areas will be permanently changed.

D) Negeri Sembilan

There are 28 landscape characters segments within HSR Project corridor in Negeri Sembilan. From these segments, only 21 segments will overlap directly with HSR structures. Three (3) segments are categorized as having major adverse impacts (**Table 7-53**). Details for the detailed visual impacts assessment for Negeri Sembilan is as per **Appendix 7N – Table 3**).

Table 7-53: Detail Visual Impacts for the State of Negeri Sembilan

| Detail Visual Impacts | Nos of Landscape Characters | Percentage (%) |
|---|-----------------------------|----------------|
| No impact (no contact with HSR structures) | 7 | 25.0 |
| Minor adverse | 11 | 39.3 |
| Adverse | 7 | 25.0 |
| Major adverse | 3 | 10.7 |

The areas that were categorized as having major adverse impacts are:

- a) *Kota Seriemas green open spaces* (segment no: 9, 10) – this vast green spaces area is located in the middle of Kota Seriemas and it is very closed with Kota Seriemas Golf Course and Club House. Part of the area is mark for retention pond and has potential to be recreational areas for the nearby residential areas. The HSR structures for this area will be elevated structure in which the elevated structure will traverse through green open spaces. The visual impacts will be irreversible and the landscape characters of these areas will be permanently changed.
- b) *Residential areas of Felda Labu Sendayan* (segment no: 20) – these areas consist of typical Felda houses but on undulating lands. Over time, the landscape of these areas has evolved into traditional look villages with orchards and ponds. The HSR structures traverse through these areas will be elevated structure and the visual impacts will be irreversible and the landscape characters of these areas will be permanently changed.

E) Melaka

There are 41 landscape characters segments within HSR Project corridor in Melaka. From these segments it was found that 28 segments will be overlapped with HSR Project. Altogether, six (6) segments are categorized as having major adverse impacts (**Table 7-54**). For detail tabulation of assessment for the state of Negeri Sembilan is as per **Appendix 7N – Table 5**).

Table 7-54: Detail Visual Impacts for Melaka

| Detail Visual Impacts | Nos of Landscape Characters | Percentage (%) |
|--|-----------------------------|----------------|
| No impact (no contact with HSR structures) | 13 | 31.7 |
| Minor adverse | 13 | 31.7 |
| Adverse | 9 | 22.0 |
| Major adverse | 6 | 14.6 |

These six (6) areas that were categorized as having major adverse impacts can be grouped into these areas;

- a) *Kg. Solok Air Limau* (segment no: 5) – it is a traditional village with compact layout and many of the houses have traditional Melaka house architecture style. The HSR structures traverse through these areas will be partly elevated structure and At-Grade. It is predicted that the visual impacts to this area will be irreversible and the landscape characters of these areas will be permanently changed.
- b) *Sg. Melaka near Kg. Pulau and Kg Solok Air Hilir* (segment no: 13) – Sg Melaka riparian areas with vast flat open spaces and greenery. The area is flank with traditional villages. Due to this visual situation, the areas provide scenic environment to the surrounding areas. The HSR structures for this area will be elevated structure in which the elevated structure will traverse through this riparian valley landscapes. The visual impacts are possibly be reversed even though the landscape characters of these areas will be permanently changed.

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- c) *Ayer Keroh* (segment no: 21, 23, 25, 26) – the area is the main entrance to Melaka from PLUS highway and the areas look green and surrounded by several tourism attractions and resort. The HSR structures traverse through these areas will be At-Grade and the area is proposed to be Melaka Station. It is predicted that the visual impacts of this areas will be irreversible and the landscape characters of these areas will be permanently changed.

F) Johor

There are 84 landscape characters segments within HSR Project corridor in Johor. From these segments it was found that 73 segments will be overlapped directly with HSR Project. For detail tabulation of assessment for Johor can be seen in **Appendix 7N – Table 5-54**.

Table 7-55: Detail Visual Impacts for Johor

| Detail Visual Impacts | Nos | Percentage (%) |
|--|-----|----------------|
| No impact (no contact with HSR structures) | 11 | 13.1 |
| Minor adverse | 38 | 45.2 |
| Adverse | 31 | 36.9 |
| Major adverse | 4 | 4.8 |

Altogether, four (4) segments are categorized as having major adverse impacts (**Table 7-56**). These 4 areas that were categorized as having major adverse impacts can be grouped into these areas;

- a) *Kg. Raja – SMK Sultan Alaudin Riayat Shah, Pagoh* (segment no: 22) – this stretch of area is mix of traditional and modern village as well as small town Pagoh. The area is also noted for the location of a Mausoleum of Sultan Alaudin Riayat Shah; a former Melaka Sultan. The HSR structures for this area will be a mix of elevated structure and At-Grade. It is predicted that the visual impacts of this areas will be irreversible and the landscape characters of these areas will be permanently changed.
- b) *Wetlands and aquaculture area, Gelang Patah* (segment no: 74) the areas involved is a natural wetland, aquaculture farms and aquaculture research center near Sg Pulau. The

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HSR structures for this area will be elevated structure in which the elevated structure will traverse through the wetlands. The visual impacts are possibly be reversed even though the landscape characters of these areas will be permanently changed.

- c) *Estuaries and the Tebrau Strait* (segment no: 83, 84) – this area is an estuaries area and the HSR Project will stop here before been continued to the Singapore side. The HSR structures for this area will be elevated structure in which the elevated structure will cross the scenic Tebrau Strait. The visual impacts are possibly be reversed even though the landscape characters of these areas will be permanently changed.

Detail impacts analysis was conducted to all the states where HSR Project will traverse. 25 landscape characters were classified as having major adverse visual impacts. (**Table 7-55** for detail distribution of impacts)

Table 7-56: Detail Visual Impacts Distribution for HSR Project

| | No Impacts (no contact with HSR structures) | Minor Adverse | Adverse | Major Adverse |
|--|--|------------------|---------|------------------|
| Federal Territory of Kuala Lumpur | 33 | 3 | 5 | - |
| Federal Territory of Putrajaya | 2 | - | - | - |
| Selangor | 34 | 11 | 7 | 12 |
| Negeri Sembilan | 7 | 11 | 7 | 3 |
| Melaka | 13 | 13 | 9 | 6 |
| Johor | 11 | 38 | 31 | 4 |
| Total | 100 | 76 | 56 | 25 |

The landscape characters with major adverse can be grouped into several zones in which there are three (3) zones in Selangor, two (2) zones in Negeri Sembilan, three (3) zones in Melaka and three (3) zones in Johor. Majority of the detail impacts are irreversible due to the facts that the HSR structures will be permanently constructed. Therefore, there is crucial to identify visual mitigation measures that can reduce the impacts of HSR Project to the visual environment.

7.15 PUBLIC HEALTH IMPACTS

7.15.1 Pre-Construction Phase

Planning for the eviction and resettlement of affected people, and relocation of commercial buildings, will be carried out in this phase. This will be proceeded with activities to relocate affected people from identified Project sites and to close down commercial business.

Resettlement of People

Potential impact: The HSR alignment crosses certain settlements and housing areas throughout its length. The resettled communities are exposed to a risk of mental stress due to involuntary movement into a new social environment. This may contribute to social friction within the communities, the occurrence of fights and injuries, feelings of fear, anger and depression and may result in homicide or suicide, in extreme cases.

7.15.2 Construction Phase

There are specific potential health related impacts that could materialize during this phase of Project. They include:

A. Workers Health

Potential Impacts: The influx of foreign as well as local workers cause spreading of certain diseases, particularly influenza (flu), malaria, tuberculosis, typhoid, leprosy, hepatitis B and sexual transmitted infections (STIs). Their presence, culture and behavior may alter and increase the current disease burden within the surrounding residential areas, including criminal and social troubles, particularly near their placement locations.

The various nationalities among the workers are also known to pose a risk of violence among the workers and within the communities living in the vicinity. Feelings of anger, frustration, discomfort or dissatisfaction often leads to the occurrence of fights, and in extreme cases, homicide.

B. Communicable Diseases

Potential Impact: Land clearing involving forest and swampy areas are directly related to the potential of migration of vectors to nearby villages and towns. In particular, the migration of *Aedes Albopictus* and *Culex* mosquito species may lead to an outbreak of dengue fever, malaria, filariasis and chikungunya. Larger vectors like rats and rodents pose a risk of diseases like leptospirosis and scrub typhus. The influx of a high number of foreign and local workers usually gives rise to the spread of respiratory problems like acute respiratory infection and tuberculosis; and gastrointestinal problems like acute gastroenteritis and diarrhoea. Poor health conditions of the workers will lead to them being unfit to work or even the potential occurrence of human errors that may end in casualties or fatalities.

7.15.3 Operational Phase

There are specific potential health related impacts that could materialize during this phase of Project development. They include:

A. Accident, Injury and Safety of Communities

Potential impact: Risk of accidents and injuries to the surrounding population due to collision with the fast-moving train along the HSR alignment from north to south. People may be injured or killed in an attempt to trespass through or cross the railway tracks.

B. Noise Disruptions to Communities

Potential impact: High noise levels produced by trains passing at high speeds may induce hearing problems over a period of time among exposed communities. In addition, it also causes non-auditory health effects such as disruption of peace and negative affects on mental health. High noise levels will cause feelings of anxiety, anger, dissatisfaction, exhaustion, aggression and depression. Noise is a major reason for the loss of sleep, which can lead to chronic fatigue. The Environmental Protection Agency states that a 35 dB sound level allows for healthy sleep. Rail wheel squeals on curves along the railway tracks and train horns are among the identified sources of potential noise that may cause annoyance, particularly to communities living adjacent to the HSR alignment.

7.16 RISK AND HAZARD IMPACTS

7.16.1 Introduction

The Risk and Hazard Assessment (RHA) study as required by Department of Environment (DOE) (2004) is to determine quantitatively the risk faced by the project component and the public within the project area and its vicinity (Impact zone). Hazard is an inherent property of a substance, agent or source of energy that have the potential to cause undesirable consequences. Risk is the probability of an unwanted event occurring due to uncontrolled release of a hazard that will produce harm to Environment, Human or property.

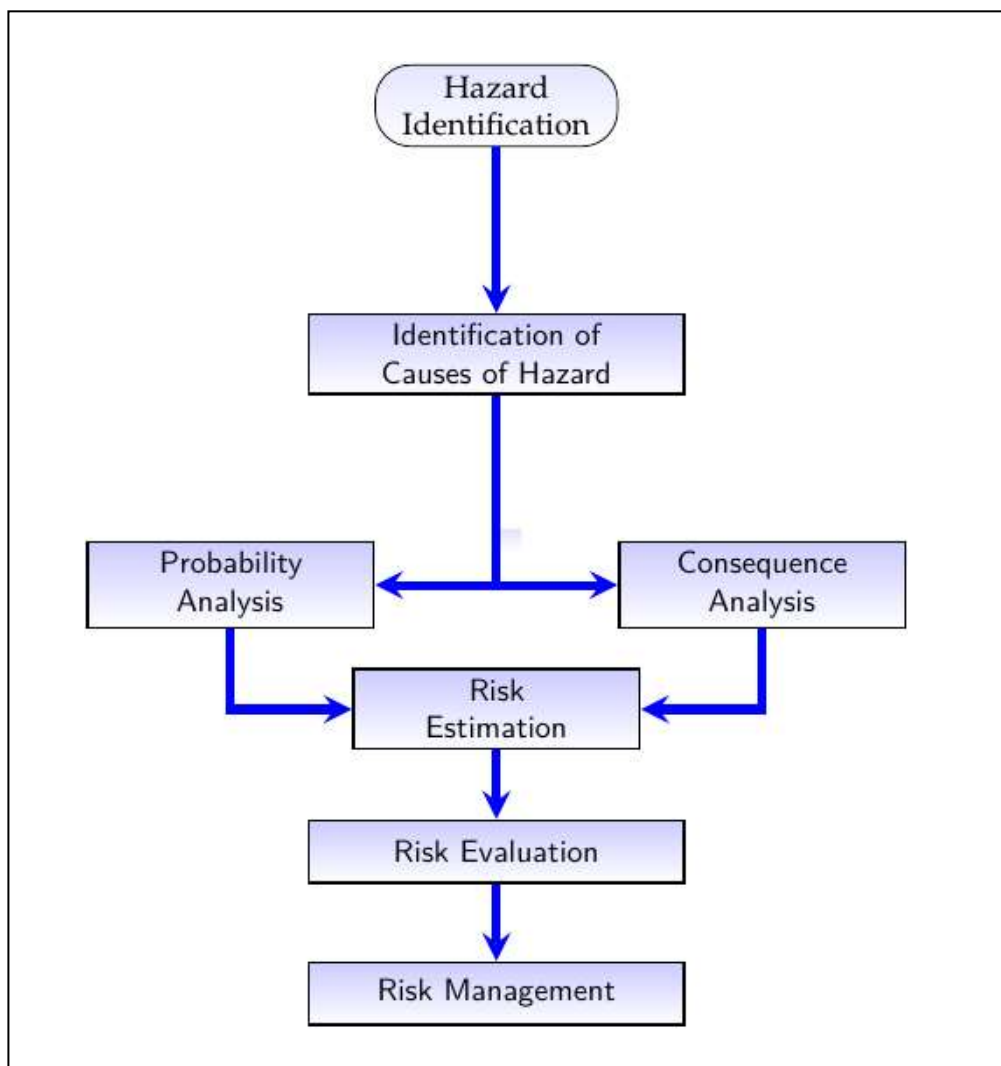


Figure 7-111: The steps in RHA Study

As an example of risk in transportation activities, supposed that a country has a population of 10 million people and on average there are 1000 fatalities per year due to transport accidents and the average transport accidents are 10000 per year. A general expression of the risk is;

$$\text{Risk} = \frac{\text{Frequency}}{\text{No. of vulnerable source exposed}}$$

Thus;

$$\frac{1000 \text{ deaths/year}}{10000 \text{ accidents/year}} = 0.01 \text{ deaths/accidents}$$

Still another form of risk indicator known as the average individual risk is expressed as;

$$\frac{1000 \text{ death/year}}{10,000,000 \text{ persons}} = 1 \times 10^{-4} \text{ deaths/person - year}$$

The risk indicator is then compared to the voluntary and involuntary risk levels in order to determine whether the risk posed by the project is acceptable.

7.16.2 Objective of Risk Assessment

The objective of the study is to determine the average individual risk (IR) which is also defined as the probability of a person being fatally affected when standing at a certain location from a potential hazard. The process of estimating the risk is shown as in the flowchart in **Figure 7-111**.

7.16.3 Scope of Study

There are two phases with the implementation of the HSR Project and in each phase there are different type of hazards and hence risks which are associated with them. The first phase is the construction and installation of the railways logistic which involves activities such as drilling, transporting, blasting and crushing which typically will expose high risk to workers and personnel on site (Hui-Nee, 2014).

The second phase of the HSR Project will be the risk expose during normal operation of the high speed train. The major hazard associated with the second phase will be probable trains

accidents that may occur that can cause major fatalities. These risks will be exposed to the passenger, the personnel around the railways logistic and the population residing or being besides the railways lines.

In determining the average individual risk (IR), the primary step is to identify potential hazards and qualitatively assess potential Safety, Health and Environmental risk to project component and public during the construction and operational phases of the Project. Secondary step is to quantitatively assess the magnitude of the risk. The third step is to propose reasonable risk mitigation measures based on the impact of the risk created during the project realization. Forth objective is to provide a framework for risk management to bring the impact to a level of As Low As Reasonably Possible (ALARP).

7.16.4 Construction Phase

As mentioned above, this is the first phase of the risk assessment study. During construction and installation of the railways logistics, the type of risk present will be similar to those found during general construction works in any development. Unless there is nearby settlement, the people who are generally exposed to this kind of risk, it will be restricted to the construction workers and personnel.

7.16.5 Study Procedures

1. Identification of Hazard;
2. Exposed population.;
3. Estimation of the probabilities/frequencies of hazardous events;
4. Determination of the individual risk (IR);
5. Determination of the risk acceptability;
6. Recommendation of appropriate measures to mitigate risk if any;

7.16.6 Identification of Hazards during Construction & Installation

The type of hazard found during construction activities can be categorized according to the type of accidents during construction. Chong and Low (2014) recorded that the causes of accident from 2005-2009 are as follow;

Table 7-57: Causes of Accidents (2005 - 2009)

| Causes | Reported Cases |
|---|-----------------------|
| Stepping on, striking against or struck by object | 8997 |
| Falls | 5209 |
| Other types of accidents | 2450 |
| Caught in between objects | 1855 |
| Overexertion or strenuous movements | 684 |

Amongst the types of accident presented, hazard from falls are the most common and critical (Bureau of Labour Statistics, 2017).

7.16.7 Exposed Population

The probable individuals that may be exposed to the hazards at the construction sites and activities are the workers, construction personnel and other populations that may need to pass or use any accessible road by the construction sites. However most of the construction sites and activities are located away from any major residential areas, except the proposed railway terminals where they are closer to some populated areas. But with proper safety practices employed at the construction sites, the only people that are unavoidably exposed to the construction risks are the workers and the construction personnel. They will be exposed according to their working schedule and shift regime. Other people or nearby pedestrian are highly unlikely to be affected or exposed to the risk or even notice any changes to their daily routine.

7.16.8 Accident Rates and Frequencies:

The frequency of constructions hazard occurrence can be taken from published data of the Fatal Accident Rates (FAR). This is a standard fatality value which is mostly used by the British Chemical industry and it is defined as follows;

$$\text{FAR} = \frac{\text{No. of fatalities} \times 10^8}{\text{Total Hours worked by all employees}}$$

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The factor 10^8 is obtained by assuming the exposure of 1000 workers working 40 hours/week at 50 weeks/year for 50 years. This is the value that can be used in the determination of the individual risk as a part of the frequency/ probability rates.

Another standard fatality value that can be used is the fatality rate which is dependent on the total number of employment. It is useful when the number of hours the workers are exposed to are not fully known. It is defined as;

$$\text{Fatality Rates} = \frac{\text{No. of fatalities} \times 10^5}{\text{Total employment}}$$

The value of 10^5 is based on 100000 workers.

There is a slight different between the two published values, however they are convertible. The national accident and fatality rate is given in **Table 7-57** for the year 2014 through 2016.

Table 7-58: National Occupational Accident & Fatality Rate

| Year | 2014 | 2015 | 2016 |
|--|-----------------------|-----------------------|-----------------------|
| Accident Rate | 3.1 | 2.81 | 2.88 |
| Fatality Rate | 4.21 | 4.84 | 4.84 |
| Individual Risk (death/person-year) | 1.01×10^{-4} | 1.16×10^{-4} | 1.16×10^{-4} |

The last row of the table is the calculated individual risk based on worker's working hours of 8 hour/day and 350 days/year of working exposure. The data solely for the construction industry is given in **Table 7-57** (Chong and Low, 2014).

Similarly, the last column of **Table 7-59** is the IR values for just the construction sector from 2000 through 2014. The IR values for last few years (2015 – 2017) are not shown because the total employment data are not available.

Table 7-59: Fatality in Malaysian's Construction Industry

| Year ^a | No. of Worker | Fatalities | FAR | *Individual Risk (death/person-year) |
|-------------------|---------------|------------|---------|--------------------------------------|
| 2000 | 759900 | 159 | 10.4619 | 2.51×10^{-4} |
| 2001 | 829800 | 89 | 5.3627 | 1.29×10^{-4} |
| 2002 | 905100 | 88 | 4.8613 | 1.17×10^{-4} |
| 2003 | 942500 | 95 | 5.0398 | 1.21×10^{-4} |
| 2004 | 890800 | 81 | 4.5465 | 1.09×10^{-4} |
| 2005 | 904400 | 127 | 7.0212 | 1.69×10^{-4} |
| 2006 | 908900 | 64 | 3.5207 | 8.45×10^{-5} |
| 2007 | 922500 | 76 | 4.1192 | 9.89×10^{-5} |
| 2008 | 998000 | 64 | 3.2064 | 7.70×10^{-5} |
| 2009 | 1015900 | 47 | 2.3132 | 5.55×10^{-5} |
| 2010 | 1983000 | 66 | 1.6641 | 3.99×10^{-5} |
| 2011 ^b | 2018000 | 51 | 1.2636 | 3.03×10^{-5} |
| 2012 | 5876934 | 67 | 0.5700 | 1.37×10^{-5} |
| 2013 | 6089054 | 69 | 0.5666 | 1.36×10^{-5} |
| 2014 | 6198657 | 72 | 0.5808 | 1.39×10^{-5} |

Source ^a : 2000 - 2010 Chong and Low (2014)

Source ^b : 2011 – 2014 DOSH(Malaysia) (2017)

7.16.9 Individual Risk and Acceptability

Based on **Table 7-59**, the individual risk for the construction and installation activities is 11.16×10^{-4} death/person-year (from 2015). This is higher than the voluntary risk set by the DOE. The EIA guideline for Risk Assessment (DOE), (2004) describes that individual risk of 1 in 10^6 in a year is the limit for residential areas and 1 in 10^5 in industrial area. The guideline is generally applicable for stationary type of hazards and thus it is arguable that it could be applicable to industrial development and construction activities. A different criteria and risk level is thought to be more appropriate and applicable.

The Health & Safety Executive (UK) (2001) gives a more general level of acceptable risk.

Table 7-60: Acceptable Level of Risk (Health & Safety Executive (UK), 2001)

| Risk Level | Description |
|--|--|
| $< 1 \times 10^{-6}$ | Broadly acceptable region |
| 1×10^{-4} to 1×10^{-6} | Tolerable region. Involuntary risk |
| 1×10^{-3} to 1×10^{-6} | Tolerable region. Voluntary risk. |
| $< 1 \times 10^{-4}$ | Unacceptable region for public or involuntary risk |
| $< 1 \times 10^{-3}$ | Unacceptable region for public or voluntary risk |

The individual risk levels calculated in the above tables (**Table 7-58** and **7-59**) showed that the results are slightly higher than the recommended level by the DOE guideline i.e. involuntary risk is 1×10^6 and the voluntary risk is 1×10^5 (Department of Environment, (DOE), 2004). However, if the IR level suggested by the Health & Safety Executive (UK) (2001) is used **Table 7-60** instead, the results are well within the tolerable region. The IR values are also decreasing over the years and thus it is reasonable to assumed that the IR value will be within the DOE recommended level in the future and may well be already within the required level if stringent safety practices is adhered at all times. For comparison, the FAR value reported in the construction industry between the US and the EU is 7.9 and 9.6 respectively (Bureau Labor Statistics, 2014). This is much higher than what is reported locally. Although we accept that the IR values would still be lower due to the bigger number of workers in those countries.

Based on the argument above, the level of IR during construction and installation phase for the Project is acceptable.

7.16.10 Risk Assessment of the High Speed Rail

Description of the Project is detailed in Chapter 5. Brief description is given here in this section only those that are relevant to the risk and hazard assessment study of the Project. This is the second phase of the QRA study and mainly revolve around the normal operation of the high speed railway transport. The main objective is to determine the IR due to the implementation of the HSR project.

The HSR Project will be used only to transport passenger. There will be no cargo of any dangerous materials or hazardous chemicals.

Study Procedures

1. Hazard identification
2. Exposed Population
3. Probability and Consequence Analysis
4. Risk Evaluation and Estimation
5. Recommendation of Safety measures
6. Conclusion

Hazard identification

The HSR will not be transporting any chemicals or hazardous materials, thus there is no possibility of any contribution of risk from chemical hazards. The main sources of hazard will be by train accidents. According to Office of Rail and Road, ORR, (2017), the number of train accidents that are possible are:

- Collisions
- Derailment
- Level crossings accidents
- Accident to persons caused by rolling stock in motion
- Fires in rolling stock.

The precursors to the accidents are;

- Broken rails
- Broken wheels or axles

- Signal passed at danger.

Although collisions and level crossing accidents are mentioned, they are highly unlikely to occur with respect to the intended project as the proposed track will be a double track system and there will underpass and overpass as regard to any level crossing. Other hazards are of minimal consequence such as tunnel portal effect, seismic constrains and hydro meteorological hazard.

Actual local train accidents data is difficult to obtain as there is virtually no available data since 1998. The last EIA study on double tracking only used data up to 1998. Another possible source is the European and United Kingdom train statistics which although may not satisfactory, they do throw some light on the hazard scenario locally.

Exposed Population/ Individual

During normal operation of the HSR, the most vulnerable people that will be exposed to the risk level from the implementation of the project are the intended passengers, employees, unauthorised persons on railway premises, level crossing users and others. However as has been mentioned above level crossing users are virtually non-existence as the intended tracks has no exposure to level crossing.

Probability and Consequence Analysis

The main objective of a probability analysis is to determine the frequency occurrences of accidents and hence the probability of accidents. There are several methods for estimating probability of failure (Fell et al., 2001);

1. Fault tree (FTA) methods - represent logical combinations of systems states and possible causes that contribute to a specified event (top event) in a railway system. This method requires the contributions and participation of experience and knowledgeable persons in HSR in order to construct a comprehensive fault-tree. Again counter checking the resulting FTA with historical performance would enhance the credibility of the estimates.
2. Event tree (ETA) methods – this is an inductive process that allows one to determine what will happen finally from an initiation event. Again, participation of experience

persons or engineers in HSR is required to perform a comprehensive analysis. And as with the FTA, historical performance data would help as a 'credibility check'.

3. Historical performance data methods - use of historical performance of similar railway system in an equivalent or similar settings would indicate probable train accident rates. The assumption is that historical accident frequency obtained would be similar to the future accident frequencies. The data from the study could also further be adjusted by experience QRA analyst to account for better safety system and better railway tracks.

Out of the three (3) methods above, historical performance method is the most useful and credible option to determine the probability of train accidents.

Trains accidents is a very low incidence for example there were no train accidents in 2014-2015 and in the UK and that has been the same case for previous eight years in succession with no passengers have died as a result of train accident (ORR,2017) .

However, there are a number of statistical safety data available (ORR (2017), European Commission (2017) and Evans (2011, 2014)) that have analysed not only the historical train accident rates but also the fatality rates for train accidents. Hence it is easier to perform the consequence analysis to determine fatality rate and subsequently the individual risk using those data rather than to start from the accidents rate. The data that are available are the train kilometre, the fatality per billion passenger kilometre (Evans 2011, 2014). Using the following relationship the IR can be calculated;

$$\text{Fatality / year} = \frac{\text{fatalities/ million train kilometer}}{\text{Train – kilometer per year}}$$

$$IR = \frac{\text{fatalities/ year}}{\text{Total Population}}$$

The previous study (DOE), 2002) on double track railway concluded that the IR is 1.53×10^{-9} fatalities/person-year based on total population of 21 million.

The data on the fatalities per million train kilometre and train-kilometre for several representative countries are given in **Table 7-61**.

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Table 7-61: Comparison of the Train Safety Statistic for Representative Country.

| Country | Train-Km (MM) | Fatality/Billion Train km (mean from 1990-2013) | Fatality/MM Train km (mean from 1990-2013) | Fatality/year | Population | Fatality/person-year |
|-----------------------|---------------|---|--|---------------|------------|-------------------------|
| EU28+NO+CH | 4349 | 1.26 | 0.00126 | 5.48 | 520382923 | 1.05 x 10 ⁻⁸ |
| Germany | 1038 | 0.64 | 0.00064 | 0.66 | 80523746 | 8.25 x 10 ⁻⁹ |
| France | 512 | 0.39 | 0.00039 | 0.20 | 65640000 | 3.04 x 10 ⁻⁹ |
| UK | 536 | 0.31 | 0.00031 | 0.17 | 63905297 | 2.60 x 10 ⁻⁹ |
| Italy | 317 | 3.39 | 0.00339 | 1.07 | 59685227 | 1.80 x 10 ⁻⁸ |
| Poland | 224 | 1.32 | 0.00132 | 0.30 | 38062535 | 7.77 x 10 ⁻⁹ |
| Spain | 189 | 1.92 | 0.00192 | 0.36 | 46727890 | 7.77 x 10 ⁻⁹ |
| Czech Republic | 161 | 5.81 | 0.00581 | 0.94 | 10516125 | 8.90 x 10 ⁻⁸ |
| Switzerland | 191 | 2.10 | 0.0021 | 0.40 | 8039060 | 4.99 x 10 ⁻⁸ |
| Austria | 150 | 1.39 | 0.00139 | 0.21 | 8451860 | 2.47 x 10 ⁻⁸ |
| Netherlands | 150 | 0.86 | 0.00086 | 0.13 | 16779575 | 7.69 x 10 ⁻⁹ |
| Sweden | 140 | 0.17 | 0.00017 | 0.02 | 9555893 | 2.49 x 10 ⁻⁹ |
| Romania | 108 | 2.06 | 0.00206 | 0.22 | 20020074 | 1.11 x 10 ⁻⁸ |
| Hungary | 116 | 1.00 | 0.001 | 0.12 | 9908798 | 1.17 x 10 ⁻⁸ |
| Belgium | 99 | 6.63 | 0.00663 | 0.66 | 11161642 | 5.88 x 10 ⁻⁸ |
| Denmark | 83 | 0.42 | 0.00042 | 0.03 | 5602628 | 6.22 x 10 ⁻⁹ |
| Slovak | 46 | 1.92 | 0.00192 | 0.09 | 5410836 | 1.63 x 10 ⁻⁸ |
| Finland | 51 | 2.53 | 0.00253 | 0.13 | 5426674 | 2.38 x 10 ⁻⁸ |
| Bulgaria | 28 | 0.35 | 0.00035 | 0.01 | 7284552 | 1.35 x 10 ⁻⁹ |
| Portugal | 37 | 4.81 | 0.00481 | 0.18 | 10487289 | 1.70 x 10 ⁻⁸ |
| Norway | 47 | 3.92 | 0.00392 | 0.18 | 5051275 | 3.65 x 10 ⁻⁸ |
| Malaysia ^a | 0.02263 | - | 2.98 | 0.07 | 31000000 | 2.18 x 10 ⁻⁹ |

Source: Evans (2011, 2014), Office of Rail and Road, ORR(2017), European Commission (2017)

^a DOE (2002) EIA on the Proposed Electrified Double Tracking Project Between Seremban-Johor Bharu- Tg Pagar.

Risk Evaluation and Estimation

The consequence of a hazard being realised is loss of life and or damage to property and environment. However in QRA, the aim is to ascertain the fatality rate and subsequently the individual risk. **Table 7-61** shows that the IR obtained for most countries are in the range of

10^{-8} and 10^{-9} . Thus the estimated IR 2.18×10^{-9} for Malaysia is reasonable. The DOE (2004) stipulated that the involuntary risk is 1×10^{-6} and the voluntary risk is 1×10^{-5} . The IR results obtained from the data show that the IR for railway transport system is well below the involuntary risk level. Hence the implementation of the HSR Project should not pose any unduly risk to people and population around the Project.

7.16.11 Risk Control Measures

The IR calculated in this phase follows the general risk found in the local construction industry. It can be seen that values are only slightly higher than the recommended level. However, in order to ensure the risk level will be well below the national level and within the ALARP (as low as reasonably practicable) condition the workers and personnel who are involve in the construction and installation activities should always adhere to the best safety principle and practices.

The focus of the RHA is to address all hazards and risks captured in the following broad categories:

- Hazards inherent during construction of stations and its support system and elevated structure;
- Hazards inherent to installation / commissioning activities;
- Hazards inherent to operation and maintenance of the HSR;
- Hazards inherent to interfacing systems and activities such as adjacent railway, overhead transmission line, utilities, etc.; and
- Possible hazards due to site location, the environment and other external factors.

The hazard categories form the starting point for identifying environmental health and safety hazards. The potential impact created by the hazards determines the risk in the Project.

The categories used in this project are listed below:

- Lifting/ dropped objects;
- Objects falling off Rolling Stock/ elevated structure/ others;
- Electrical systems – touch potential/ earthing;
- Electrical systems – Electromagnetic Interference;
- Unauthorised access – station/ guide way / Plant rooms;

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- Wrong routing;
- Overrun from the guide way;
- Uncontrolled speed/ derailment/ collision;
- Maintenance vehicle operation;
- Fire in Rolling Stock / Station / Tunnel
- Passenger behaviour;
- Dangerous substances/ materials;
- Activities near elevated structure;
- Ground investigation/ excavation/ Tunnelling damage to utilities, Existing Buildings and Ground level (Cave in);
- Machinery;
- Dust/ noise/ vibration;
- Structure collapse;
- Subsidence/ ground movements/ etc.;
- Adverse environment conditions i.e. flood and high wind velocity;
- Traffic;
- Evacuation/ emergency.
- Working over Water

Once a hazard and its potential causes were identified, the possible consequences were qualitatively evaluated. Any consequence with the potential to cause injury, fatality or multiple fatalities was identified.

Considering probability of occurrence, consequence level and the effectiveness of the safeguards provided, the risk arising from each identified hazard was ranked into four broad categories (defined in EN 50126) as provided in **Table 7-62**.

Table 7-62: Risk Category and Actions

| Risk Category | Actions to be applied against each category |
|----------------------|--|
| Intolerable | Risk shall be eliminated |
| Undesirable | Risk shall only be accepted when risk reduction is impracticable and with the agreement of the Railway Authority or the Safety Regulatory Authority, as appropriate. |

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| Risk Category | Actions to be applied against each category |
|----------------------|---|
| Tolerable | Risk may be considered acceptable with adequate control and with the agreement of the Railway Authority |
| Negligible | Risk may be considered acceptable with/ without the agreement of the Railway Authority |

Where risk was assessed to be Intolerable or Undesirable with the currently proposed safeguards, additional risk reduction, control or mitigation measures were proposed. Where risk was assessed to be Tolerable, the proposed safeguards were reviewed to assess whether they provide sufficient risk reduction. Where required additional recommendations have been proposed.

7.16.12 Risk and Hazard Assessment for Construction Phase

Table 7-63: Individual Risk during Construction Phase

| Hazard Categories | Causes | Potential Impacts | Risk Categories |
|----------------------------|--|--|------------------------|
| 1.Lifting/ dropped objects | 1. Precast block dropped (e.g. cable failure, human error) during construction | 1. Dropping of precast block onto public area. Multiple fatalities to the public | Negligible |
| | 2. Gantry falling eg. Installation error/ removal of gantry. | 1. Gantry falling onto public area/including roads. Multiple fatalities to the public | Tolerable |
| | | 2. Potential objects falling onto the track/ Rolling Stock of the existing lane leading to potential Rolling Stock derailment and impacts to public. | Tolerable |
| | 3. Gantry failure falling eg. Overloading and imbalance. | 1. Dropping of gantry/ precast block onto public area/including roads. Multiple fatalities to the public | Tolerable |
| | | 2. Potential objects falling onto the track/ Rolling Stock of the existing lane leading to potential Rolling Stock derailment and | Tolerable |

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| Hazard Categories | Causes | Potential Impacts | Risk Categories |
|--|---|--|-----------------|
| | | impacts to public. | |
| | 4. Scaffolding falling eg. poor installation, high winds, etc | 1. Dropping of large object onto public area. Potential injuries and may be a couple of fatalities to public. | Negligible |
| | | 2. Potential objects falling onto the track/ Rolling Stock of the existing lane leading to potential Rolling Stock derailment and impacts to public. | Negligible |
| 2. Objects falling off Elevated structure | 1. Poor housekeeping during construction | 1. Potential loose objects falling onto existing railway/ public areas and causing fire | Tolerable |
| | 2. Objects falling from station during construction | 1. Large objects falling onto affected road leading to traffic incidents. | Negligible |
| 3. Electrical systems - touch potential/ earthing | 1. Lightning during construction/ local storm. Local storm which could affect construction areas in places where there is no storm through electrical conduction. | 1. Potential fatalities/ public exposure | Tolerable |
| 4. Electrical system - Electromagnetic Interference | 1. Poor quality cable | 1.EMI disturbing the signals | Negligible |
| 5. Unauthorized access - station/ guide way/ Plant rooms | 1. Unauthorized access during construction | 1. Potential injuries/ fatalities to intruder | Negligible |
| | 2. Unauthorized access during construction around the built up areas. (Higher risk of intrusion). | 1. Potential injuries/ fatalities to members of the public | Tolerable |
| 6. Wrong routing | 1. Land survey report is wrong | 1. The alignment of the guide way is built wrongly | Negligible |
| 7. Overrun from the guide way | 1. Poor integration of the rail interface | 1. Rail overruns out of the station into public area leading to potential injuries/ fatalities and property damage | Negligible |

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| Hazard Categories | Causes | Potential Impacts | Risk Categories |
|--|---|---|-----------------|
| 8. Uncontrolled speed/ derailment/ collision | 1. Train signal system failure | 1. Rolling Stock does not stop as desired. Potential to derailment of the Rolling Stock or collision at the final point | Negligible |
| 9. Dangerous substances/ materials | 1. Poor housekeeping/ use of combustible material | 1. Potential of fire / poisoning during construction | Negligible |
| 10. Activities near existing railway | 1. Piling work eg. Vibration/ piling machinery access. | 1. Vibration damage to existing railway and leading to potential accident | Negligible |
| | 2. Exposure/ close proximity to overhead catenaries of existing railway line | 1. Exposure/ close proximity to overhead catenaries of existing railway. Potential fatalities/ public exposure | Tolerable |
| 11. Ground investigation/ excavation/ Tunneling damage to utilities, Existing Buildings and soil level (Cave in) | 1. Piling works for soil investigation | 1. Potential damage to utilities, no specific concern to the public. | |
| | 2. Construction activities damage gas pipelines (small pipelines) | 1. Potential fire and explosion | Negligible |
| | 3. Cut and Cover for Railway Tunnel | 1. Potential to damage the existing utilities in the area of excavation | Tolerable |
| | | 2. Cave in of the walls leading to fatality of workers | Negligible |
| | | 3. Hazardous Gas leak due to trapped gas in the ground. | Negligible |
| | 4. Use of TBM for Railway Tunnel. | 1. Third party property damage | Tolerable |
| | 5. NATM technique (blasting procedure employing explosives to move the tunnel face forward) | | |
| 12. Machinery | 1. Crane/machinery unsecured | 1. Potential damage to existing structures or public causing fatalities | Negligible |

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| Hazard Categories | Causes | Potential Impacts | Risk Categories |
|--|--|---|-----------------|
| 13. Dust/ noise/ vibration | 1. Piling works | 1. Potential damage to building eg. window building cracking | Negligible |
| | 2. Noise generated during construction | 1. Potential health/ injuries issues | Negligible |
| | 3. Generation of dust during construction | 1. Potential health/ injuries issues | Negligible |
| 14. Structure collapse | 1. Integrity of the built structure | 1. Potential damage to existing structures or public causing fatalities | Negligible |
| 15. Subsidence/ ground movements/ etc. | 1. Potential subsidence to existing track during construction. | 1. Potential damage to existing railway accident/ public impact (road) | Tolerable |
| | | 2. Potential subsidence near existing affected road leading to traffic accidents | Tolerable |
| 16. Adverse environment conditions | 1. Earthquakes | 1. Potential damage to guide ways, structure falling, public impact | Negligible |
| | 2. Thunder storm combined with drain blockage/ overloading of drain system | 1. Potential damage to nearby buildings | Undesirable |
| 17. Traffic | 1. Improperly cleaned vehicles from construction area to public areas | 1. Potential increase risk of traffic accident due to mud spill on public road/ increase generation of dust | Tolerable |
| | 2. Improper loading/ unloading from construction area | 1. Damage to properties leading to potential public impacts | Tolerable |
| | 3. Improper management of Heavy construction vehicles ingress/ egress | 1. Potential increase risk of traffic accident on public road | Tolerable |
| | 4. At station exit by road vehicle | 1. Potential increase risk of traffic accident on public road/ increase generation of dust | Negligible |
| | 5. Construction access/ restriction along major roads. | 1. Potential increase risk of traffic accident on public road due to | Tolerable |

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| Hazard Categories | Causes | Potential Impacts | Risk Categories |
|---------------------------|---|---|-----------------|
| | | road and narrowing during construction/ increase construction vehicle traffic. | |
| 18. Evacuation/ emergency | 1. Fire during construction | 1. Improper management of fire leading to public impacts. | Tolerable |
| 19. Working over Water | 1. People / Material drop into water (river) while working above water surface. | 1. People drowning (Fatality) 2. Potential damage to the boats using the river | Tolerable |

From a social / community perspective, construction activities around the HSR alignment will require careful planning so as to minimise risks to the community both urban and rural.

Based on the results of this RHA study, the health and safety risk posed by the HSR Project during the construction stage is well controlled with the risk identified generally within the “Tolerable” or “Negligible” region.

7.16.13 Operational Phase

Risk Management

The estimated IR in the above analysis shows that the public and the population around the proposed will not be exposed to any high level risk. However to keep the IR and any residual risks level down the project proponent show institute management procedures which enhance safety on rail.

Worker Competency

The importance of workers’ competency is never to be under emphasized. It is common knowledge that most accidents are caused by human error. It is therefore necessary to instill safety awareness to the railways’ employee right from the start. The training of the employee should include safety procedures and practices. To ensure their alertness and competency are maintained, frequent drilled on emergency response plan should be periodically executed. Derailment and train collision with other trains or objects in part are as a result of

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driver's error. Over speeding may lead to derailment and failing to follow signal at danger can cause collisions with other entity. Train drivers should be properly trained to observe train speed limits and to follow other safety procedures. They should be well verse with proper safety rules and regulations.

Maintenance workers either on contract or permanent workers should be ascertained to be well versed with safe work procedures before they are allowed to work on the track. Track work should be less labour intensive to reduce risk exposure. If sufficient increase in train traffic density is established it may justify the installation of automated track safety warning system or a more comprehensive train protection warning system.

Emergency Planning

Emergency response plan should be well devised and regulated to mitigate any emergency situations. Detail procedures and rules should be made available and known to all relevant personnel.

Public Awareness

At some locations, the train traverse heavily populated areas. Residents as the employees and workers near the railway route should be made aware of the existence of the railway within their neighbors. They should be informed periodically or continuously with labels and text boards on what and what not to be done to ensure train and public safety. These measures should be the responsibility of the project proponent so that the public will perceive that the railway operation is as safe as any other everyday activities.

Table 7-64: Individual Risk during Operational Phase

| Hazard Categories | Causes | Potential Impacts | Control Measures | Risk Categories |
|--|---|---|---------------------|-----------------|
| 1 Objects falling off Rolling Stock/ Guide way/ Others | 1. Objects falling from station bridge during operation [generic for footpath bridge station] | 1. Potential public injuries/fatalities | 1. Method Statement | Undesirable |

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| Hazard Categories | Causes | Potential Impacts | Control Measures | Risk Categories |
|---|--|--|---|-----------------|
| 2. Electrical systems - touch potential/ earthing | 1. Potential intrusion along the guide way | 1. Potential fatalities | 1. Intrusion detection provided and restricted access | Negligible |
| | 2. Potential intrusion into the substation | 1. Potential fatalities | 1. Intrusion detection provided and restricted access, eg. lock devices. | Negligible |
| | 3. Lightning during operation | 1. Potential fatalities/ public exposure | 1. Lightning arrestor provided during operation along the guide way. | Negligible |
| 3. Electrical system - Electromagnetic Interference | 1. EMI from the transmission line to the railway affecting railway system (transmission line running parallel to the railway | 1. Potential Rolling Stock collision/ derailment leading to public impact. | | Undesirable |
| 4. Overrun | 1. Potential Rolling Stock overrun due to system failure | 1. Potential Rolling Stock accident leading to public fatalities | 1. Buffer stop provided | Tolerable |
| | | | 2. Automatic Train Protection (ATP) | |
| | | | 3. Low speed limit at area of concerns eg. Cross over, depot, and station approaches. | |
| 5.Overspeed/ derailment/ collision | 1. Potential collision | 1. Rolling Stock derailling and going off the guide way | 1. Automatic Train Protection (ATP) | Negligible |
| | | | 2. Manual Operation monitored by ATP. | |

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| Hazard Categories | Causes | Potential Impacts | Control Measures | Risk Categories |
|-----------------------|---|--|--|-----------------|
| | | | 3. Low speed limit at area of concerns eg. Crossover, depot, and station approaches. | |
| | 2. Broken rail/ rail fitting | 1. Rolling Stock derailling and going off the guide way | 1. Rail integrity checks during operation | Negligible |
| | | | 2. Standard Operating Procedures (SOP) | |
| | 3. Malfunction of switches | 1. Rolling Stock derailling and going off the guide way | 1. Automatic Train Supervision System. | Negligible |
| | | | 2. Standard Operating Procedures (SOP) | |
| 6. Rolling Stock fire | 1. Rolling Stock on fire arriving at station (open / in Tunnel) | 1. Potential fire escalation at station with potential public fatalities | 1. Fire alarm detection | Negligible |
| | | | 2. Automatic Train Protection (ATP) prevent Rolling Stock to reach station | |
| | | | 3. Fire escape system well designed within the tunnel to prevent any fatality | |
| | | | 4. Open station design | |
| 7. Station fire | 1. Station fire e.g. plant room fire | 1. Potential fire escalation at station with potential public fatalities | 1. Fire alarm detection | Negligible |
| | | | 2. Non-combustible material NFPA130 | |

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| Hazard Categories | Causes | Potential Impacts | Control Measures | Risk Categories |
|---------------------------|--|--|--|-----------------|
| | | | 3. Evacuation to comply with NFPA 130 | |
| | | | 4. Open station design | |
| | | | 5. Passenger escape to safe area | |
| 8. Passenger behavior | 1. Smoking inside the station causing fire | 1. Potential fire escalation at station with potential public fatalities | 1. Smoke detectors 2. Warning and signage | Tolerable |
| | 2. Intrusion of passenger into the guide way | 1. Potential injuries/ fatalities to member of public | 1. Falling objects detector on track at station | Negligible |
| | | | 2. Warning and signage 3. Controlled paid area | |
| 9. Dust/ noise/ vibration | 1. Noise generated by the rail vehicles | 1. Potential health/ injuries issues | 1. Safe noise level specified | Negligible |
| | | | 2. Noise monitoring during operation | |
| | | | 3. In build-up areas, noise barriers are provided | |
| | 2. Generation of dust/ noise during maintenance eg. grinding | 1. Potential health/ injuries issues eg. exposure to metal dust | 1. Dust is typically contained within the guide way | Negligible |
| | | | 2. Grinding to be maintained outside operating hours | |
| | | 2. High level of noise from grinders | 1. Grinding to be maintained outside operating hours | Negligible |

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| Hazard Categories | Causes | Potential Impacts | Control Measures | Risk Categories |
|------------------------------------|---|---|--|-----------------|
| 10. Adverse environment conditions | 1. Earthquakes | 1. Potential damage to guide ways, structure falling, public impact | 1. Not earthquake zone, compliance with earthquake design guidelines | Negligible |
| | 2. Thunder storm combined with drain blockage/overloading of drain system in Urban environment. | 1. Potential damage to nearby buildings | 1. Operating procedure to clear drains | Tolerable |

Based on the results of this RHA study, the health and safety risk posed by the HSR Project during the Operational phase is well controlled with the risk identified generally within the “Tolerable” or “Negligible” region.

7.17 ECONOMIC VALUATION OF ENVIRONMENTAL IMPACTS

7.17.1 Introduction

The HSR Project is expected to positively contribute towards the development of the national economy by compressing geographical distances and rebalancing economic growth by spreading development to the southern region. More directly, it will also have impact on the economy through construction activities and subsequent commercial/economic activities associated with an improved transportation network. Notwithstanding these economic benefits, the proposed project activities may bring about some negative environmental impacts although many of them will be mitigated, as required by law, through the EIA approval process.

Notwithstanding the above-mentioned benefits, associated project activities are also likely to cause some negative environmental impacts although many of them will be mitigated as required by law, through the EIA approval process. Some of the negative impacts cannot, however, be completely mitigated. In compliance with the EIA approval process, these negative (and positive) impacts need to be quantified (to the extent possible) in monetary terms. The quantification is focused at monetizing the degradation (or gain) in services obtainable from the environment. This valuation exercise allows for the appreciation of the significance of the environmental values of the services that will be gained or lost due to project implementation. It also complements the project proponent's economic feasibility study by explicitly incorporating the estimated environmental cost into the analysis.

Environmental services that will be foregone (or obtained) following project implementation are real opportunity cost (or gain) to society. Hence, it is imperative that their values are estimated. Recent advances in both theoretical and empirical methods and protocols of environmental resources evaluation enable practitioners to produce reliable monetary estimates of environmental services with a reasonable degree of reliability.

This section contains the methods and results of the economic valuation of the environmental impacts of the proposed project. The methods of valuation generally abide by the "Guidelines on Economic Evaluation of Environmental Impacts for EIA Projects" published by the Department of Environment. The main goal of this chapter is to quantify

the losses and gains (if any) in environmental services as a result of the proposed project implementation. It is worth noting that this evaluation is not a full-blown project economic feasibility evaluation and should never be viewed as such.

7.17.2 Objective

In general, the objective of the economic evaluation is to assess the impacts of the proposed project on services obtainable from the surrounding environment. This requires the economic evaluation of the changes (both negative and positive if any) in environmental services arising from project implementation.

7.17.3 Methodology

One important step in the valuation process revolves around the need to ensure valid attribution of impacts on environmental services to the proposed project. In order to satisfy this requirement, physical environmental impacts that can reasonably be attributable to the proposed project must first be demonstrated. In other words, the approach requires the establishment of a clear link between project impacts on the physical functions of the environment and the alteration of the quality and quantity of streams of environmental goods and services. The Guidelines on the Economic Valuation of the Environmental Impacts for EIA projects is very clear in this regards where it specifies that:

“... a key issue is to identify and quantify the changes in the flow of goods and services produced by the environment which are impacted by a development project, and then to monetize these changes into costs or benefits”.

The valuation process can be divided into nine distinct steps, as follows:

Step 1: Identify the project stakeholders.

The stakeholders that are affected by the alteration in environmental services are identified in this step.

Step 2: Define the “with project” and “without project” scenario.

A contrast is provided under the “with” and “without” project scenarios, as opposed to “before” and “after” scenarios. It involves the conceptualization of the “with” and “without” project scenarios. For the purpose of the assessment, the “with project” scenario is defined as the situation where the high speed rail system is constructed and operated. “Without project” scenario is depicted as the situation in which the proposed project is not implemented i.e. maintenance of the status quo.

Step 3: Describe the physical impacts.

A listing of potential physical impacts of the project that can be reasonably attributed to the project is prepared and described by focusing on the physical extent of the impact and the link between the project and its impact on the flow of environmental services.

Step 4: Quantify the impacts on the environment over the duration of the project.

The physical impacts of the project on the environment is linked and explained in quantitative manner. Quantifications of physical impacts are required in order to translate the alteration in environmental services into monetary values. This is achieved through scientific assessments of the study team that include among others air quality, water quality specialist, and land use specialist.

Step 5: Monetize the impacts.

The physical impacts identified in Step 4 are quantified in monetary terms, at this stage. This is attained by using market and non-market valuation techniques. For the purpose of this study, values of similar environmental services obtained in other studies are used as the bases of evaluation. This procedure is commonly known in the literature as the benefit transfer method.

Step 6: Discounting.

The streams of costs and benefits are discounted to present values using several discount rates (4%, 6% and 8%).

Step 7: Determine the Net Present Value.

The net present value is computed in this step by adding up the discounted values of the losses and gains in environmental services.

Step 8: Perform sensitivity analysis.

Sensitivity test is conducted for different discount rates to demonstrate the impact of variation in rates on the net present value of the environmental costs and benefits.

Step 9: Make a recommendation.

An overall assessment is made based on the magnitude of Net Present Values at different levels of discount rates.

7.17.4 Identification of Incremental Costs and Benefits

It is imperative that only incremental environmental impacts are considered in the evaluation exercise. Considering only “incremental change in environmental services” means that only marginal costs and benefits that arise as a result of choosing the “with project” option (instead of “without project”) is subjected to evaluation.

Based on discussions with other study team members responsible to assess the impacts of the project on all environmental components as well as reports prepared by them, **Table 7-61** shows the environmental services that may change as a result of project implementation. The table describes the kind and spatial extent of the impacts as well as their respective locations. From among these potential impacts, mitigation measures are considered, and only those that remains to be significant are evaluated in this study.

7.17.5 Valuation of Costs and Benefits

Five environmental services (**Table 7-62**) can potentially change as a result of project implementation. These changes can arise from removal of mangrove forest vegetation, the loss of land planted with oil palm, the loss of land planted with rubber trees, reduction in greenhouse gas emission, and degradation of water quality that feeds into intake points. Of

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the 5 potential changes in environmental services, four are considered to be significant enough for evaluation. These are changes due to i) removal of mangrove forest vegetation, ii) loss of land planted with oil palm, iii) loss of land planted with rubber trees, and iv) reduction in greenhouse gas emission. The nature of losses in environmental services for each of the impact is described and evaluated in **Table 7-65**.

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Table 7-65: Potentially Affected Environmental Services

| No. | Environmental Components | Nature of Potential Impacts/ Environmental Services ¹ Affected | Location and Physical Extent of Impacts / Stakeholders | Remarks |
|-----|--|--|---|---|
| 1. | Landuse- Removal of mangrove forest vegetation | Clear felling of the forest area within the project's right of way. Permanent loss of forest area and associated environmental services obtainable from the forest reserve such as carbon sink and timber production. | A small part of Sg. Pulai Forest Reserve (mangrove forest) in Gelang Patah. The size of the affected forest area is 25 ha = 62.5 acres. Although minor, the stakeholders affected are charcoal and poles producer, state government (tax revenue/premium), local population dependent on fishery and general population (loss of carbon sink thus increasing greenhouse gasses and impacts of climate change). | Total Economic Value requires the valuation of carbon sequestration function, charcoal and pole production, fishery resources, recreation and non-use values. |
| 2. | Landuse- Loss of land planted with oil palm | Land previously planted with oil palm trees will be lost within the project's right of way. Environmental services obtained from such land are environmental inputs to oil palm fresh fruits production as well as carbon sink function. | Oil palm areas that will be affected are located in the states of Negeri Sembilan (349 ha), Melaka (18 ha) and Johor (774 ha). The total size of the area affected is therefore estimated at 1,141 ha. Oil palm industry, and general population (carbon fixing thus reducing greenhouse gasses and impacts of climate change). | The values of carbon sink function, and oil palm fresh fruit production are computed net of non-environmental inputs (seedlings, labour, fertilizers, infrastructure and other inputs). In addition, although less than forested area, oil palm plantation is expected to fix carbon. |

¹ Environmental services refer to qualitative functions of natural non-produced assets of land, water and air. They are typically categorized into: a) disposal services which reflect the functions of the natural environment as an absorptive sink, (b) productive services which reflect the economic functions of providing natural resource inputs and space for production and consumption, and (c) consumption services which provide for physiological as well as recreational and related needs of human beings. (Source: Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, United Nations, New York, 1997).

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| No. | Environmental Components | Nature of Potential Impacts/ Environmental Services ¹ Affected | Location and Physical Extent of Impacts / Stakeholders | Remarks |
|-----|--|--|---|--|
| 3. | Landuse- Loss of land planted with rubber | Land previously planted with rubber trees will be lost within the project's right of way. Environmental services obtained from such land are environmental inputs to latex and rubber wood production as well as carbon sink function. | Rubber holdings that will be affected are located in Negeri Sembilan (63 ha), Melaka (362 ha) and Johor (477 ha). The total size of rubber-planted area affected is estimated at 902 ha. /Rubber industry, and general population (carbon fixing thus reducing greenhouse gasses and impacts of climate change). | The values of carbon sink function, and latex and rubber wood production are computed net of non-environmental inputs (seedlings, labour, fertilizers, infrastructure and other inputs). Rubber plantation also fixes carbon. |
| 4. | Air Quality – Reduction in greenhouse gas emission | Shifting motor vehicle and aircraft users to HSR can potentially bring about a net reduction in greenhouse gas emissions. Reduction in air emission of greenhouse gases (CO ₂) will contribute towards overcoming global warming impacts. | Within (and beyond) national border. /Malaysians and global population in general. | The emission of CO ₂ is expected to be reduced when the proposed HSR begins operation as people using motor vehicles and aircraft switch to HSR, although the amount of reduction depends on the relative fuel efficiency of a transport mode and the HSR. The assessment quantifies the potential reduction in CO ₂ through modal shift from motor vehicles and aircrafts to HSR. |
| 5. | Water Quality – Water supply to intake points | Construction activities for river and stream crossings will affect environmental services including reduction in water quality of the streams and rivers thus potentially impacting the quality of water at intake points. | Water intakes that are located downstream of the project alignment include: i. Sg. Semenyih Water Intake (about 0.125 km away). ii. Sg. Labu WTP Intake (about 3.0 km | Minimal water quality impact is expected because mitigation measures such as site specific erosion and sediment control measures, and construction of bridges at river crossings will be |

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| No. | Environmental Components | Nature of Potential Impacts/ Environmental Services ¹ Affected | Location and Physical Extent of Impacts / Stakeholders | Remarks |
|-----|--------------------------|--|--|---|
| | | | <p>away).</p> <p>iii. Durian Tunggal Water Intake (about 1.0 km away)</p> <p>iv. Sg. Kesang/ Lanchang Intake Point (about 1.0 km away)</p> <p>Water treatment plant operators, public utilities, and commercial, industrial and residential users of water sourced from the intake points.</p> | implemented in the proposed project. No valuation is therefore necessary. |

7.17.5.1 Removal of Mangrove Forest Area

In general, the benefits obtainable from environmental services from mangrove forest areas can be divided into use and non-use values, the sum of which is known as the Total Economic Value. Further, use value can be divided into direct and indirect use value, option use value and bequest value. A schematic diagram showing a listing of values of services obtainable from a mangrove forest area is provided in **Figure 7-112**. For the purpose of valuation, appropriate techniques must be applied in order to arrive at valid monetary values for the different services

Mangroves that are part of the coastal ecosystems, provide a wide range of economic and ecological services. The environmental services provided by mangrove forest (and hence affected by the proposed project) include:

- (a) Production of charcoal and poles
- (b) Provision of feeding and breeding grounds for shrimp, fish, crab and mollusc
- (c) Tourism and recreation
- (d) Provision of traditional goods
- (e) Carbon sequestration function
- (f) Shoreline protection
- (g) Option, existence and biodiversity values

The total size of forest area affected is only 25 ha (62.5 acres) based on the worst case scenario, 100 m corridor, Sg. Pulai Forest Reserve in Gelang Patah. However, because environmental services provided by mangrove forest areas are generally highly valued, this study proceeds to evaluate value of services that will be lost when the area is cleared along the HSR alignment.

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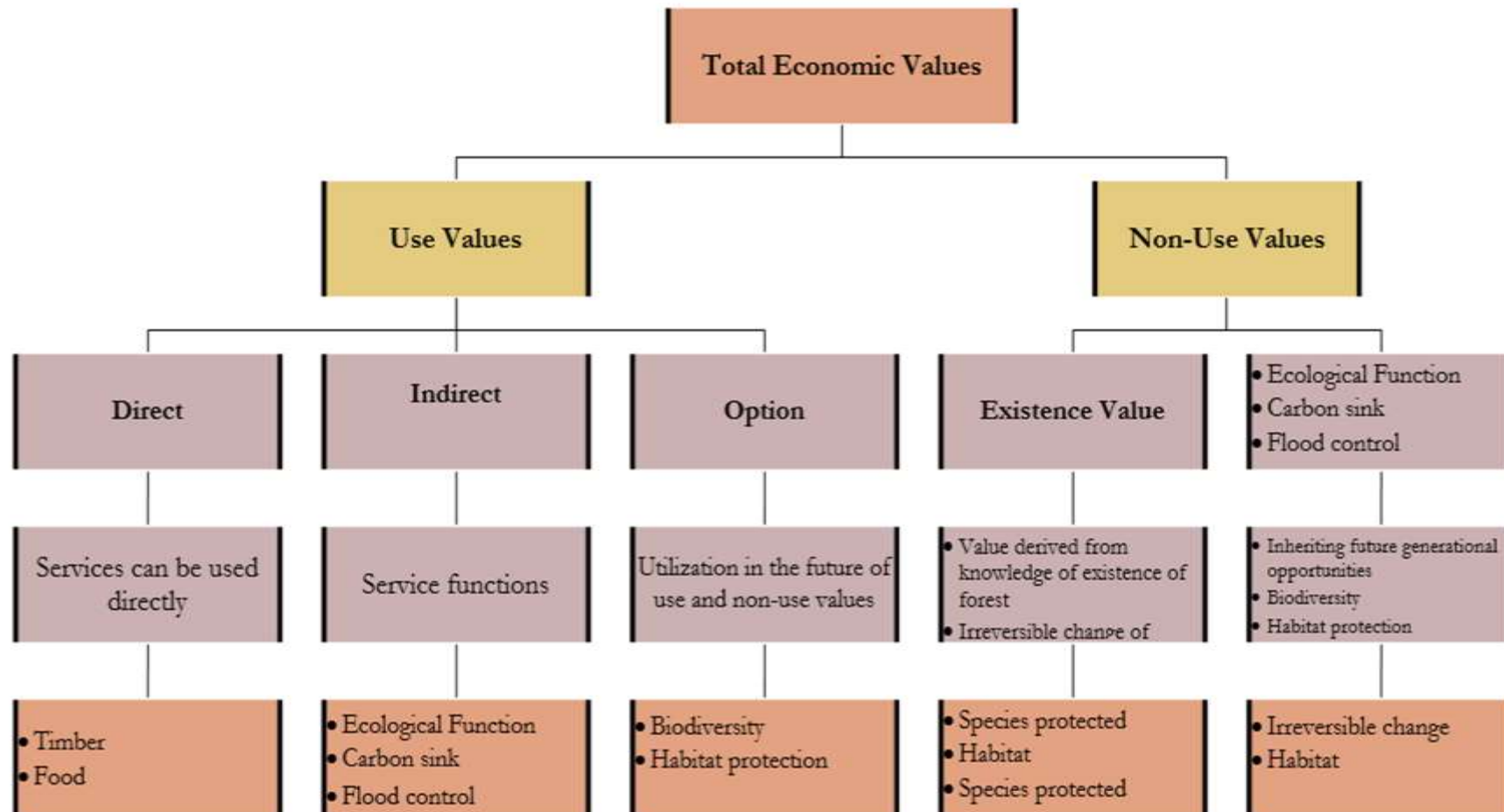


Figure 7-112: Total Economic Value of Forest Area (Adapted from Munasinghe dan Lutz (1993))

(a) Charcoal and Poles

Mangrove areas produce timber, fuelwood, and building materials. Sathirathai (2000) estimated that the annual net return from charcoal obtained from Thailand's mangrove forest is estimated to be \$91.97. According to Sivakumar and Fernando (1997) *Rhizophora* sp. used in housing construction generates Rs. 1 million/ha/year in Sri Lanka. Bann (1997) estimated that the net benefit from selective commercial mangrove cutting schemes was estimated to be \$ 20 million/ year in Indonesia. This study adopts a current value of RM 11,051.98/ha/year of mangrove area after incorporating inflationary factor and exchange rate conversion determined from prior studies.

(b) Shrimp, fish, crab and mollusc

Mangroves are feeding and breeding ground for fish. Bann (1999) estimated the direct use value of mangroves from captured fishery at US\$ 526/ha/yr in Malaysia. In several other developing countries, the annual value of the fish caught in mangroves, varies between US\$900 and US\$12,400/ha of mangrove (Rodríguez 2001). The economic value of the fisheries function of mangroves has been reviewed or estimated by many researchers including Hamilton & Snedker, (1984); Ruitenbeek, (1991); Gren & Soderqvist, (1994); Hambrey, (1997); Gilbert & Janssen, (1997) and Costanza et al, (1997) The values ranged from \$66 to almost \$3,000 /ha/yr. Christensen (1982) estimated the fisheries function in Thailand at 130/ha/yr. Lal (1990) estimated the fisheries function of mangroves in Fiji at US\$ 100/ha/yr while Ruitenbeek (1992) estimated the same in Indonesia at US\$ 117/ha/yr. Janssen and Padilla (1996) estimated the mangrove fisheries function in Philippines at US\$ 60/ha/yr.

For this study the environmental services offered by mangroves habitat for fishery feeding and breeding ground is evaluated based on expected total catch (quantity) and market price of fishery resources. Further computation produces an estimate of RM 7,285.48/ha/year as the value of fishery resources that are dependent on the mangrove area. This estimate is obtained after incorporating inflationary factor and exchange rate conversion for values estimated by previous studies.

(c) Tourism and Recreation

This component of the study analyses the economic value of recreation benefits of mangrove forests for both domestic and international tourists. Avoiding degradation or loss in mangrove areas increases the opportunity for recreation, which will lead to the promotion of the tourism industry. Costanza et al (1989) in the United States estimated recreational value of mangroves using both these methods and came up with \$ 70.67 per visitor from TCM and \$ 47.11 per visitor from CVM.

In Sri Lanka the estimates for recreational and tourism value of mangrove areas have been estimated at US\$ 1,196/ha/year for international tourism and the corresponding value for domestic tourism is US\$ 933 (Batagoda 2003). The only Malaysian study on the value of mangrove forest from the tourism perspective can be found in Bennett and Reynolds (1993) that estimated that tourism value derived from mangrove forest in Sarawak was US\$ 473.26/ha/year. Cesar (1996) proposed a net return factor of 60% of revenue thus giving a net benefit of US\$283.96. Hence the value adopted for this study is RM 1,706.57/ha/year.

(d) Traditional Use

Mangrove forests provide several marketed and non-marketed forest resources in the form of traditional use products like nipah shingles, resins, medicines and cane products. For example, Ruitenbeek (1992) estimated the annual net benefit from medicinal plants to be \$15/ ha/ yr. from a mangrove forest in Indonesia. Because the values derived from traditional products are small, this study ignores the traditional use value of mangrove forest.

(e) Biodiversity Values

Mangroves store valuable genetic resources in addition to providing habitats for migratory species. In general, biological diversity helps the mangroves in maintaining ecological (carrier) and regulatory functions, especially in undisturbed state. Several studies have estimated the economic value of biodiversity maintenance by estimating several functions of mangroves. Ruitenbeek (1992) in an Indonesian study, estimated the capturable biodiversity benefits of mangroves if they are maintained intact at US\$1,500 per square kilometer per year that translates into US\$15/ha/year for mangrove forest in Indonesia. Several other studies have estimated the plant based pharmaceutical value of mangroves ranging from

US\$0.1 to US\$ 61/a/year (Bann 1997). This study uses an adjusted figure of RM 141.22/ha/year for the biodiversity value of the mangrove areas.

(f) Carbon Sequestration

Mangroves play an important role in regulating carbon dioxide in the global atmosphere by absorbing CO₂ and storing it in their biomass. Emission of carbon dioxide leads to greenhouse effect i.e. a process in which the emission of infrared radiation by the atmosphere warms a planet's surface. Carbon sequestration does the reverse. According to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPPC), the globally averaged surface temperature is projected to increase by between 1.4 and 5.8°C from 1990 to 2100 under business-as-usual, and sea levels are expected to rise by between 9 and 88 cm over the same period. If nothing is done to reduce these changes, they will have major consequences for the ecosystem and our economies. With a 5-6°C warming, a real possibility for the next century, models estimate an average of 5-10% loss in global GDP, with poor countries suffering costs in excess of 10% GDP (Stern Review, 2006).

In order to reduce greenhouse gas emission, the international community has agreed (the Kyoto Protocol) on introducing three market-based "flexible mechanisms" that allows for emission trading. Emission trading price (usually quoted in tone carbon dioxide equivalent) provides a good basis for the quantification of the impact of greenhouse gases on the environment. Created in 2005, the European Union Emission Trading Scheme (EU ETS) is the largest multi-national, emissions trading scheme in the world. The treaty binds most developed nations to a cap and trade system for the six major greenhouse gases. Emission quotas were agreed by each participating country, with the intention of reducing their overall emissions by 5.2% of their 1990 levels by the end of 2012. Under the treaty, for the 5-year compliance period from 2008 until 2012, countries discharging less than their quota can sell credits to others that go above their quota.

The treaty essentially sets up an emission trading system to control pollution by providing economic/financial incentives to reduce emissions of pollutants including carbon. Under the system a central authority sets a cap on the amount of a pollutant that can be emitted. Companies are issued emission permits and hold an equivalent number of credits which represent the right to emit a specific amount. Companies that need to increase their emission allowance must buy credits from those who pollute less. The transfer of allowances

is referred to as a trade. In effect, the buyer is paying a charge for polluting, while the seller is being rewarded for having reduced emissions by more than was needed. By doing so, companies that can reduce emissions most cheaply will do so, achieving the pollution reduction at the lowest possible cost to society.

There are currently active trading programs in several pollutants. For greenhouse gases, the largest is the European Union Emission Trading Scheme. Historically the price per ton of carbon has been fluctuating mostly within the band of €10 to €30. However, the latest data in recent years shows that price had fallen to between €3.00 to €6.00/ton. At the same time, there was a perceptible upward trend in the price level thus warranting the use of the late 2016 price of about €5/ton for the purpose of valuation in this EIA report.

Carbon sequestration benefits of the mangrove forest can then be estimated by calculating the total biomass per ha and then applying appropriate conversion factors to obtain carbon equivalents. The daily net CO₂- fixations of several dominant mangrove species found in Thailand as well as Sri Lanka such as *Avicennia marina*, *Rhizophora apiculata*, and *Excoecaria agallocha* have been estimated at 14,942 mg at 14,942 mg CO₂/m²/day, 24,235 mg CO₂/m²/day, and 14,097 mg CO₂/m²/day respectively. Based on these results, average value for carbon-fixation of mangroves in Kanjanadit District in Thailand was estimated at 15.1 tonC/ha/yr.

For this study, the value of mangrove forest service obtained in the form of carbon sequestration function is estimated at RM 339.75/ha/year.

(g) Shoreline Protection

Mangroves function as natural barriers of the shoreline from erosion. The shoreline protection value is normally estimated by using the replacement cost approach i.e. the cost of building artificial structures. The cost of constructing protective structures has been estimated at RM 1.36 million/km in Malaysia (Hiew and Lim 1994). Estimates for building a seawall and breakwater is about US\$1.2 million/km (Dahuri 1995). Taking the Malaysian study as the basis for computing the shoreline protection service provided by mangrove area, this study determines that the value of this function is RM 6,476.43/ha/year.

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Table 7-66 provides the estimated environmental cost of mangrove removal per ha. The total estimated environmental value from the mangrove area is RM27,001.44/ha/year. This rate is applied to the total loss of 25 ha in mangrove area.

Table 7-66: Estimated Environmental Value of Mangrove Area by Service Type (2014 price)

| | Environmental Services | Unit Value (RM/ha/year) |
|---------------------------------|--|------------------------------------|
| Direct use value | Production of charcoal/poles | 11,051.98 |
| | Feeding and breeding ground and habitat for | 7,285.48 |
| | shrimp/fish/crab/molusc | |
| | Tourism and recreation | 1,706.57 |
| | Traditional use | - |
| Indirect use value | Carbon sequestration | 339.75 |
| | Shoreline protection | 6,476.43 |
| Option/Non-use value | Biodiversity values | 141.22 |
| Total | | 27,001.44 |

7.17.5.2 Loss of Non-Forested Area - Oil Palm

Apart from the removal of forest area, the proposed project will also cause the loss of areas planted with commercial crops (oil palm and rubber). The total oil palm area affected is estimated at 1,141 ha (349 ha in Negeri Sembilan, 18 ha Melaka and 774 ha in Johor).

There are some environmental services provided by oil palm areas. In particular, the existing oil palm land produces valuable fresh fruits, the production of which requires environmental inputs (services). This loss in environmental services is valued in this study by estimating the resource rent which is equivalent to the value of the fruits net of non-environmental inputs. This approach is consistent with the procedure of subtracting harvesting cost and profit margin in determining the stumpage value of timber.

In addition to non-environmental inputs at the operation and harvesting stage, the estimation of the resource rent must take into account the oil palm areas' development expenditure that is known to be very significant. For a given plot of oil palm area, deducting expenditure on

non-environmental inputs from the value of fresh fruit bunch harvest leads to under or over valuation of environmental service during different points of the trees' life-cycle. For example, in the initial years, there will be “negative” environmental service using this computation. On the other hand, in years when the trees are most productive, environmental service flow will appear to be very large. To overcome this difficulty, this study assumes that the age of trees is uniformly distributed over their life-cycle of 30 years. By doing so, over and under valuation of environmental services are netted out to correctly represent the value of the contribution of the environment to oil palm production in any given year.

Another environmental service provided by the oil palm areas is carbon sequestration function. The value of this environmental service loss is also evaluated in this study using method that is similar to valuing carbon sequestration function of forest.

(i) The Economic Value of Oil Palm Fresh Fruits

The economic value of oil palm fresh fruits can be ascertained by subtracting the cost of production (including initial capital cost) and imputed profit rate, from the revenue obtained from fresh fruits produced. By definition, the value is equal to the market price of fresh fruits minus all non-environmental input cost. The relevant price is, of course, the price that prevails in a competitive fresh fruits market.

This method of value computation is known as the residual value method where, (over the project life):

$$L_R = P.Q - C_p - C_e - \pi$$

where;

- L_R = Value of fresh fruits
- P = Market price of fresh fruits
- Q = Quantity of production
- C_p = Cost of operating and maintaining the plantation
- C_e = Cost of plantation establishment
- π = Profit margin

(a) Marker Price for Oil Palm Fresh Fruits

The Malaysia Palm Oil Board does publish indicative fresh fruit price on a daily basis. This price is supposed to provide some kind of an industry average price that buyers and sellers could expect to pay and receive for oil palm fresh fruit. The price, as expected, does fluctuate considerably depending on demand and supply conditions. In the recent time the price has been hovering around the RM500/ton marks. This indicative price is used in this study.

(b) Production Cost of Oil Palm Fresh Fruits

A relatively recent study published in the Oil Palm Industry Economic Journal published by the Malaysia Palm Oil Board (Mohd Basri Wahid and Mohd Arif Simeh, 2009) on the economics of oil palm plantation details out all costs involved in the establishment and maintenance of plantation. Liberally drawing from this study and after escalating all cost at an average annual rate of 3.5%, **Table 7-67** provides the range of values for all relevant cost parameters on a per hectare basis.

Table 7-67: Cost Parameters for Establishment and Operation of Oil Palm Plantation Per Hectare

| | Capital Expenditure | Operation & Maintenance/Year for Subsequent Years |
|------------------------------|---------------------|---|
| Initial Development - Year 1 | 6,347.69 | - |
| Initial Development - Year 2 | 2,256.96 | - |
| Initial Development - Year 3 | 2,186.43 | - |
| Upkeep | - | 453.84 |
| Fertilizer | - | 1,354.72 |
| Harvesting | - | 729.15 |
| Transportation | - | 712.80 |
| General Charges | - | 977.20 |

Very little is known about the size of the profit ratio but a profit range of between 25% and 35% appears to be a reasonable assumption to make. This study sets the profit ratio at 30 percent.

(c) Oil Palm Yield

Oil palm yield is dependent on the age of the plantation trees. For this study, yield estimates by age of tree stock per ha is obtained from Azman Ismail and Mohd Noor Mamat, (2002). The estimates are given in **Table 7-68**. The oil palm plantation requires three (3) years to establish and harvesting can begin in year 4 with peak yield from year 8 to 19. Thereafter yield begins to decline gradually to around 15 ton/ha by year 30.

Table 7-68: Oil Palm Fresh Fruit Bunch Yield

| Year | Yield (ton/ha) | Year | Yield (ton/ha) |
|------|----------------|------|----------------|
| 1 | 0 | 16 | 19.58 |
| 2 | 0 | 17 | 19.58 |
| 3 | 0 | 18 | 19.33 |
| 4 | 4.52 | 19 | 19.08 |
| 5 | 7.53 | 20 | 18.83 |
| 6 | 12.55 | 21 | 18.58 |
| 7 | 16.57 | 22 | 18.33 |
| 8 | 19.08 | 23 | 18.08 |
| 9 | 19.83 | 24 | 17.83 |
| 10 | 20.34 | 25 | 17.58 |
| 11 | 20.34 | 26 | 17.33 |
| 12 | 20.09 | 27 | 16.83 |
| 13 | 20.09 | 28 | 16.33 |
| 14 | 19.93 | 29 | 16.08 |
| 15 | 19.58 | 30 | 15.58 |

(ii) The Economic Value of Carbon Sink Function of Oil Palm Plantation

The rate of biomass accumulation is positive for a plantation with growing oil palm trees. Hence, we can expect a net carbon sequestration and a rising stock of carbon right from planting to just before replanting.

(a) Carbon Stock and Fixing of Oil Palm Plantation

Using findings from the study by Germer and Sauerborn (2008), the carbon fixing rate/ha/year can be computed by factoring in the ultimate biomass content of oil palm plantation and biomass-carbon conversion rate. The estimated total biomass after 30 years is estimated at 99.0 ton/ha comprising 72.0 ton/ha above ground biomass, 24 ton/ha below ground biomass and 3.0 ton/ha of ground cover biomass. The estimated biomass accumulation rate is 3.3 ton/ha annually.

The amount of carbon fixed is therefore 40.3 ton/ha over a 30-year cycle by utilizing the percentage of carbon content of oil palm trees and ground cover of 40.4% and 50.0% respectively. The corresponding rate of carbon fixing is therefore on average estimated at 1.34 ton/ha/year for 30 years.

(b) Value of Carbon Sequestration

For consistency, the same carbon price used for mangrove forest carbon sequestration function of €5/ton is used. The annual economic value of carbon sequestration lost due to removal of oil palm land is provided in **Tables 7-68, 7-69 and 7-70**.

7.17.5.3 Loss of Non-Forested Area – Rubber

The HSR Project will also cause the loss of areas planted with rubber trees. The total size of rubber-planted area affected is estimated at 902 ha (63 ha in Negeri Sembilan, 362 ha Melaka and 477 ha in Johor).

Like oil palm, there are some environmental services provided by rubber-planted areas. In particular, the rubber-planted area produces commercially valuable latex and rubber-wood, the production of which requires environmental inputs (services). This loss in environmental services is valued in this study by estimating the resource rent which is equivalent to the value of the latex and rubber wood net of non-environmental inputs. This approach is consistent with the procedure of subtracting harvesting cost and profit margin in determining the stumpage value of timber.

In addition to non-environmental inputs, the estimation of the resource rent must take into account the rubber-planted areas' development expenditure that is known to be very significant. For any given period say a year, deducting expenditure on non-environmental inputs from the value of latex and rubber wood for the current year, leads to under or over valuation of environmental service during different points of the trees' life-cycle. For example, in the initial years, such computation will lead to environmental service being valued as "negative". On the other hand, in years when the trees are most productive in producing latex and when rubber wood is harvested, environmental service flow will appear to be very large. To overcome this difficulty, this study assumes that the age of trees are uniformly distributed over their life-cycle (evaluation period of 30 years). By doing so, over and under valuation of environmental services are netted out to correctly represent the value of the contribution of the environment to latex and rubber-wood production in any given year.

Another environmental service provided by the rubber-planted areas is carbon sequestration function. The value of this environmental service loss is also evaluated in this study using method that is similar to valuing carbon sequestration function of forest.

(i) The Economic Value of Latex and Rubber Wood

The economic value of latex can be ascertained by subtracting the cost of production (including initial capital cost) and imputed profit rate, from the revenue obtained from latex produced. By definition, the value is equal to the market price of latex minus all non-environmental input cost. The relevant price is, of course, the price that prevails in a competitive latex market.

The economic worth of rubber wood logs can be ascertained by referring to its stumpage value which in turn is the financial value of standing logs. By definition, stumpage value is equal to the price paid by the rubber wood log mill less the cost of transporting the logs to the mill and all non-environmental input cost in the establishment of the plantation. The relevant price is, of course, the price that prevails in a competitive rubber wood market.

Again consistent with the valuation of timber, the residual value method is adopted for the computation of economic value of rubber wood logs. The value of rubber logs has to be adopted to include the cost of plantation establishment. Variables that are required in order

to compute the value of rubber logs include market price, volume, cost drivers as well as profit margin. The residual value is computed as:

$$L_R = P - C - \pi$$

where;

- L_R = Value of logs
- P_R = Price
- C_h = Cost of logs harvesting
- C_e = Cost of plantation establishment
- π = Profit margin

The residual value of latex is also determined using the above formula by switching "logs" to "latex".

(a) Marker Price for Rubber Wood and Latex

The daily latex price per kg for November 2017 of about RM5.80 (Malaysia Rubber Board) is used as the market price parameter for latex in this study.

The Malaysia Timber Board does publish indicative rubber wood price on a regular basis. This price is supposed to provide some kind of an industry average price that buyers and sellers could expect to pay and receive for rubber logs. Marketable rubber logs are of two types: bole log and canopy wood. The canopy wood price is typically set at about 35% of bole log price on a cubic metre basis (MTIB, 2017). The latest available indicative price is RM180/tonne for bole log. The conversion rate ordinarily used to convert volume into weight is $180 \text{ m}^3 = 130 \text{ tonne}$. The price and conversion rates are used in this study.

(b) Production Cost of Latex, Rubber Wood and Profit Ratio

A Malaysian Rubber Board publication (Mohamad Johari, 2006) on the economics of rubber forest plantation details out all costs involved in the establishment and maintenance of rubber plantation. Liberally drawing from this study and after escalating all cost at an average annual rate of 3.5%, **Table 7-69** provides the range of values for all relevant cost parameters on a per hectare basis.

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Table 7-69: Cost Parameters for Establishment and Operation of Rubber Plantation Per
Hectare

| Details | Capital Expenditure (Yr 0 & Yr 1) | Operation & Maintenance/Year for Subsequent Years |
|--------------------------|-----------------------------------|---|
| Land Preparation | 1,313.97 | NA |
| Lining Holing & Planting | 1,131.48 | NA |
| Planting Material | 2,007.46 | NA |
| Weeding | 407.33 | 127.02 - 305.13 |
| Manurig | 583.99 | 671.59 - 1,007.38 |
| Pruning | 87.60 | 29.20 - 87.60 |
| Pest & Disease Control | 21.90 | 11.68 - 21.90 |
| Infrastructure | 111.40 | 1.90 - 248.19 |
| Fencing/Boundaries | 58.40 | NA |
| Drainage | 47.45 | 0 – 7.30 |
| Fixed Assets | 498.58 | 0 - 546.76 |
| Management Overheads | 652.61 | 196.37 - 430.69 |
| Tapping and Stimulation | - | 1,214.69 - 5,972.74 |
| Other Field Cost | 32.85 | 39.42 - 52.56 |

Very little is known about the size of the profit ratio since prior studies has been few and far between. Awang Noor (1999) did however estimate that the profit ratio is in the range of 20 to 30 percent for log harvesting. Mohamad Johari (2006) also indicates that a profit range of 20-30% is a reasonable assumption to make. This study sets the profit ratio at 30 percent.

(c) Latex Production and Stock of Rubber Wood

Latex production also depends on a variety of parameters. The average latex production of 2,650kg/ha/yr (Malaysia Rubber Board) is used to estimate the amount of latex production for the HSR Project.

The rubber plantation requires 8 years to establish and tapping can only commence in the 9th year for a period of 7 years. Thereafter the cycle of plant establishment, operation and harvesting is repeated.

The total amount of harvestable rubber wood logs depends on the number of trees per ha, clone type and logging cycle. For this study, the estimate of the stock of rubber wood logs per ha is obtained from Mohamad Johari (2006). A typical rubber forest plantation has about 524 trees/ha and each tree can on average produce bole log amounting to 0.5 m³ and canopy wood amounting to 0.3 m³.

(ii) The Economic Value of Carbon Sink Function of Rubber Plantation

The rate of biomass accumulation is positive for a plantation with growing rubber trees. Hence, we can expect a net carbon sequestered and a rising stock of carbon right from planting to harvesting. There is some indication that following through on the usage of rubber wood, rubber plantation become carbon neutral at twice its planting cycle (Liew 2001). The unpublished study traces the use and re-use of rubber wood in arriving at the conclusion.

(a) Carbon Stock and Fixing of Rubber Plantation

Conservatively assuming that only biomass in the form of bole log amounting to 0.5 m³ and canopy wood amounting to 0.3 m³ per tree were generated over one harvesting cycle of 16 years, the carbon fixing rate/ha/year can be computed by factoring in planting density and biomass-carbon conversion rate. As mentioned earlier, 524 trees/ha is a typical planting density for rubber plantation. It is therefore estimated that the amount of carbon fixed over a 16 year cycle is 419.2 m³/ha or about 302.8 ton/ha. Since, only about 45% of the total dry biomass constitutes carbon (Lasco, et. al, 2003), the amount of carbon fixed is 136.2 ton/ha over a harvesting cycle of 16 years.

This gives us an estimated biomass accumulation rate of 18.9 ton/ha annually. The corresponding rate of carbon fixing is therefore 8.5 ton/ha/year for 16 years.

(b) Value of Carbon Sequestration

For consistency, the same carbon price used for mangrove forest carbon sequestration function of €5/ton is applied. The annual economic value of carbon sequestration lost due to removal of rubber-planted land is provided in **Tables 7-68, 7-69 and 7-70**.

7.17.5.4 Reduction in Green House Gas Emission from Modal Shift

The emission of CO₂ is expected to be reduced when the HSR begins operation as people using motor vehicles and aircraft switch to HSR, although the amount of reduction depends on the relative fuel efficiency of a particular transport mode to the HSR. For example, CO₂ emission per passenger km for short haul flight is estimated at 172.71 g/passenger km (DEFRA, 2012) compared to 50.0 g per passenger km for rail travel (Britain's Transport Infrastructure Rail Electrification, 2009). This section quantifies the potential reduction in CO₂ as a result of modal shift from motor vehicles and aircrafts to HSR.

CO₂ is released indirectly by the HSR operation as traction power is source from the electricity power plants. However, emission from HSR operation is expected to be offset by the reduction in the number of motor vehicles and aircraft usage as users switch to HSR. The greenhouse gas of concern is CO₂ as other greenhouse gas such as methane and nitrous oxide are relatively minor.

The net change in CO₂ emission from modal shift to the HSR is computed based on the formula below:

Net change in CO₂ emission = Reduction in CO₂ emission by other modes (cars, buses, existing rail and aircraft) as users switch to HSR *minus* Increase in CO₂ resulting from HSR operation (including induced demand).

(i) Emission Factors and Parameters

The emission factors and parameters are provided by the air quality consultant for the purpose of estimating the net impact of HSR operation on CO₂ emission.

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The emission factors and parameters that were used in the calculations of CO₂ emissions are:

- a. The percentage of shifted passenger km by mode for air, cars, buses and rail based on impact of HSR on other modes (Chapter 3, Demand and Revenue): 46%, 10%, 25% and 23%;
- b. CO₂ emission factor for private car: 77.30 g per vehicle km, assuming average occupancy of 2.5 (Global Environment Facility (GEF), 2010);
- c. CO₂ emission factor for bus: 135.52 g per passenger km (Department of Environment, Food and Rural Affairs, UK (DEFRA), 2012);
- d. CO₂ emission factor for aircraft passengers (short haul; flight distance <785 km): 172.71 g per passenger km (Department of Environment, Food and Rural Affairs, UK (DEFRA), 2012);
- e. Emission factor for passenger train: 50.0 g/km pp (Britain's Transport Infrastructure Rail Electrification, 2009).

(ii) Ridership and Passenger KM Projection

The annual ridership projection is provided in Chapter 5 of this report. It is expected to grow from 15.2 million passengers in the initial year of operation to 37.8 million passengers in the 30th year of operation. The ridership figures are then converted to passenger km by multiplying the number of passengers by segment with the respective segment distance. Summing up the passenger km value by segment over all segments produces the total passenger km.

(iii) Change in CO₂ Emission

The annual total passenger km figure is then applied in combination with the emission factors and parameters, and percentage of modal shift to compute the change in emission by transport mode. The sum of the change (reduction) in emission by transport mode *plus* the increase in emission due to induced demand gives the net impact of the HSR on CO₂ emission.

(iv) Value of Emission Reduction

For consistency, the same carbon price of €5/ton is used in valuing the value of the reduction in emission. The annual economic value of emission reduction from modal shift made possible by the HSR operation is provided in **Tables 7-70, 7-71 and 7-72**.

7.17.5.5 Overall Assessment

Tables 7-70, 7-71 and 7-72 show the streams of discounted environmental costs/benefits for a period of 50 years that can be attributed to the HSR Project. The 8% rate is chosen to reflect the market rate of interest conventionally use for Project evaluation while the 6% and 4% rates are more appropriate for social/ environmental evaluation.

After discounting at the rate of 4%, the total present value of the stream of net loss in environmental services amounts to RM20.054 million over a 50-year period. The present value is relatively small because the economic value of the reduction in environmental services from the loss of mangrove, oil palm and rubber land is almost fully compensated by the economic value of the reduction in CO₂ emission due to modal shift.

When 6% and 8% rates of discount are used, the corresponding value of environmental services loss are RM26.056 million and RM27.932 million respectively. Note that the present value of environmental service loss increases with the discount rate. This is due to the fact that larger environmental gain from reduction in vehicle emission, as users switch to the HSR, builds up over time. The process of discounting naturally results in gain that will be obtained in the distant future becoming small in present value terms, thus resulting in more negative values for higher discount rates. This study also notes that the Present Values should not be construed as indicating project feasibility. They rather provide some indication of the magnitude, in monetary terms, of the net change in the flow of environmental services as a result of the implementation of the Project.

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Table 7-70: Estimates of the Discounted Environmental Cost and Benefit (Discount Rate = 4%)

| Yr | Loss of Env Services from Mangrove-Direct Use Value | Loss of Env Services from Mangrove-Indirect Use Value | Loss of Env Services from Mangrove-Option/ Non Use Value | Loss in Oil Palm Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Oil Palm Land - Carbon Sequestration | Loss in Rubber Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Rubber Land - Carbon Sequestration | Gain from Reduction in CO ₂ Emission due to Mode Switching | Net Gain/(Loss) in Environmental Services |
|----|---|---|--|---|--|---|--|---|---|
| 0 | (501,101) | (191,324) | (3,531) | (2,749,014) | (119,379) | (2,617,236) | (163,211) | 623,766 | (5,721,029) |
| 1 | (481,828) | (183,966) | (3,395) | (2,643,282) | (114,787) | (2,516,573) | (156,934) | 1,059,449 | (5,041,316) |
| 2 | (463,296) | (176,890) | (3,264) | (2,541,618) | (110,372) | (2,419,782) | (150,898) | 1,460,695 | (4,405,425) |
| 3 | (445,477) | (170,087) | (3,139) | (2,443,863) | (106,127) | (2,326,713) | (145,094) | 1,829,509 | (3,810,991) |
| 4 | (428,343) | (163,545) | (3,018) | (2,349,868) | (102,046) | (2,237,224) | (139,514) | 2,167,791 | (3,255,766) |
| 5 | (411,868) | (157,255) | (2,902) | (2,259,489) | (98,121) | (2,151,177) | (134,148) | 2,477,346 | (2,737,613) |
| 6 | (396,027) | (151,206) | (2,790) | (2,172,585) | (94,347) | (2,068,440) | (128,988) | 2,759,882 | (2,254,502) |
| 7 | (380,796) | (145,391) | (2,683) | (2,089,024) | (90,718) | (1,988,884) | (124,027) | 3,017,019 | (1,804,504) |
| 8 | (366,150) | (139,799) | (2,580) | (2,008,677) | (87,229) | (1,912,389) | (119,257) | 3,250,295 | (1,385,785) |
| 9 | (352,067) | (134,422) | (2,481) | (1,931,420) | (83,874) | (1,838,835) | (114,670) | 3,461,162 | (996,607) |
| 10 | (338,526) | (129,252) | (2,385) | (1,857,135) | (80,648) | (1,768,111) | (110,260) | 3,651,001 | (635,315) |
| 11 | (325,506) | (124,281) | (2,293) | (1,785,707) | (77,546) | (1,700,107) | (106,019) | 3,643,079 | (478,379) |
| 12 | (312,986) | (119,501) | (2,205) | (1,717,026) | (74,564) | (1,634,718) | (101,941) | 3,630,365 | (332,576) |
| 13 | (300,948) | (114,904) | (2,120) | (1,650,986) | (71,696) | (1,571,844) | (98,020) | 3,613,240 | (197,280) |
| 14 | (289,373) | (110,485) | (2,039) | (1,587,487) | (68,938) | (1,511,389) | (94,250) | 3,592,062 | (71,900) |

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| Yr | Loss of Env Services from Mangrove-Direct Use Value | Loss of Env Services from Mangrove-Indirect Use Value | Loss of Env Services from Mangrove-Option/ Non Use Value | Loss in Oil Palm Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Oil Palm Land - Carbon Sequestration | Loss in Rubber Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Rubber Land - Carbon Sequestration | Gain from Reduction in CO ₂ Emission due to Mode Switching | Net Gain/(Loss) in Environmental Services |
|----|---|---|--|---|--|---|--|---|---|
| 15 | (278,244) | (106,236) | (1,960) | (1,526,430) | (66,287) | (1,453,258) | (90,625) | 3,567,167 | 44,128 |
| 16 | (267,542) | (102,150) | (1,885) | (1,467,721) | (63,737) | (1,397,364) | (87,140) | 3,538,874 | 151,336 |
| 17 | (257,252) | (98,221) | (1,813) | (1,411,270) | (61,286) | (1,343,619) | (83,788) | 3,507,481 | 250,233 |
| 18 | (247,358) | (94,443) | (1,743) | (1,356,990) | (58,929) | (1,291,941) | (80,566) | 3,473,268 | 341,298 |
| 19 | (237,844) | (90,811) | (1,676) | (1,304,798) | (56,662) | (1,242,251) | (77,467) | 3,436,497 | 424,988 |
| 20 | (228,696) | (87,318) | (1,611) | (1,254,614) | (54,483) | (1,194,472) | (74,487) | 3,397,417 | 501,736 |
| 21 | (219,900) | (83,960) | (1,549) | (1,206,360) | (52,387) | (1,148,531) | (71,623) | 3,361,230 | 576,921 |
| 22 | (211,442) | (80,730) | (1,490) | (1,159,961) | (50,373) | (1,104,357) | (68,868) | 3,322,801 | 645,580 |
| 23 | (203,310) | (77,625) | (1,432) | (1,115,347) | (48,435) | (1,061,882) | (66,219) | 3,282,355 | 708,104 |
| 24 | (195,490) | (74,640) | (1,377) | (1,072,449) | (46,572) | (1,021,040) | (63,672) | 3,240,105 | 764,864 |
| 25 | (187,971) | (71,769) | (1,324) | (1,031,201) | (44,781) | (981,769) | (61,223) | 3,196,250 | 816,210 |
| 26 | (180,742) | (69,009) | (1,273) | (991,540) | (43,059) | (944,009) | (58,869) | 3,150,975 | 862,475 |
| 27 | (173,790) | (66,354) | (1,224) | (953,403) | (41,403) | (907,701) | (56,604) | 3,104,454 | 903,974 |
| 28 | (167,106) | (63,802) | (1,177) | (916,734) | (39,810) | (872,789) | (54,427) | 3,056,851 | 941,005 |
| 29 | (160,679) | (61,348) | (1,132) | (881,475) | (38,279) | (839,220) | (52,334) | 3,008,318 | 973,850 |
| 30 | (154,499) | (58,989) | (1,089) | (847,572) | (36,807) | (806,943) | (50,321) | 2,958,995 | 1,002,776 |

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| Yr | Loss of Env Services from Mangrove-Direct Use Value | Loss of Env Services from Mangrove-Indirect Use Value | Loss of Env Services from Mangrove-Option/ Non Use Value | Loss in Oil Palm Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Oil Palm Land - Carbon Sequestration | Loss in Rubber Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Rubber Land - Carbon Sequestration | Gain from Reduction in CO ₂ Emission due to Mode Switching | Net Gain/(Loss) in Environmental Services |
|----|---|---|--|---|--|---|--|---|---|
| 31 | (148,557) | (56,720) | (1,047) | (814,973) | (35,391) | (775,906) | (48,386) | 2,892,279 | 1,011,299 |
| 32 | (142,843) | (54,539) | (1,006) | (783,628) | (34,030) | (746,064) | (46,525) | 2,826,317 | 1,017,683 |
| 33 | (137,349) | (52,441) | (968) | (753,489) | (32,721) | (717,369) | (44,735) | 2,761,151 | 1,022,080 |
| 34 | (132,066) | (50,424) | (930) | (724,508) | (31,463) | (689,778) | (43,015) | 2,696,817 | 1,024,633 |
| 35 | (126,987) | (48,485) | (895) | (696,643) | (30,252) | (663,248) | (41,360) | 2,633,347 | 1,025,477 |
| 36 | (122,103) | (46,620) | (860) | (669,849) | (29,089) | (637,739) | (39,769) | 2,570,770 | 1,024,741 |
| 37 | (117,406) | (44,827) | (827) | (644,085) | (27,970) | (613,210) | (38,240) | 2,509,111 | 1,022,545 |
| 38 | (112,891) | (43,103) | (795) | (619,313) | (26,894) | (589,625) | (36,769) | 2,448,392 | 1,019,002 |
| 39 | (108,549) | (41,445) | (765) | (595,493) | (25,860) | (566,947) | (35,355) | 2,388,632 | 1,014,218 |
| 40 | (104,374) | (39,851) | (735) | (572,589) | (24,865) | (545,142) | (33,995) | 2,329,847 | 1,008,296 |
| 41 | (100,359) | (38,318) | (707) | (550,567) | (23,909) | (524,175) | (32,688) | 2,252,290 | 981,567 |
| 42 | (96,499) | (36,844) | (680) | (529,391) | (22,989) | (504,014) | (31,430) | 2,177,252 | 955,404 |
| 43 | (92,788) | (35,427) | (654) | (509,030) | (22,105) | (484,629) | (30,222) | 2,104,655 | 929,801 |
| 44 | (89,219) | (34,065) | (629) | (489,452) | (21,255) | (465,989) | (29,059) | 2,034,421 | 904,754 |
| 45 | (85,788) | (32,754) | (604) | (470,627) | (20,437) | (448,067) | (27,942) | 1,966,477 | 880,258 |
| 46 | (82,488) | (31,495) | (581) | (452,526) | (19,651) | (430,833) | (26,867) | 1,900,749 | 856,308 |

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| Yr | Loss of Env Services from Mangrove-Direct Use Value | Loss of Env Services from Mangrove-Indirect Use Value | Loss of Env Services from Mangrove-Option/ Non Use Value | Loss in Oil Palm Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Oil Palm Land - Carbon Sequestration | Loss in Rubber Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Rubber Land - Carbon Sequestration | Gain from Reduction in CO ₂ Emission due to Mode Switching | Net Gain/(Loss) in Environmental Services |
|----|---|---|--|---|--|---|--|---|---|
| 47 | (79,316) | (30,283) | (559) | (435,121) | (18,896) | (414,263) | (25,833) | 1,837,169 | 832,898 |
| 48 | (76,265) | (29,119) | (537) | (418,385) | (18,169) | (398,330) | (24,840) | 1,775,667 | 810,023 |
| 49 | (73,332) | (27,999) | (517) | (402,294) | (17,470) | (383,009) | (23,885) | 1,724,986 | 796,481 |
| PV | (11,195,334) | (4,274,466) | (78,879) | (61,417,009) | (2,667,099) | (58,472,905) | (3,646,380) | 136,670,027 | (5,082,044) |

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Table 7-71: Estimates of the Discounted Environmental Cost and Benefit (Discount Rate = 6%)

| Yr | Loss of Env Services from Mangrove-Direct Use Value | Loss of Env Services from Mangrove-Indirect Use Value | Loss of Env Services from Mangrove-Option/ Non Use Value | Loss in Oil Palm Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Oil Palm Land - Carbon Sequestration | Loss in Rubber Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Rubber Land - Carbon Sequestration | Gain from Reduction in CO ₂ Emission due to Mode Switching | Net Gain/(Loss) in Environmental Services |
|----|---|---|--|---|--|---|--|---|---|
| 0 | (501,101) | (191,324) | (3,531) | (2,749,014) | (119,379) | (2,617,236) | (163,211) | 623,766 | (5,721,029) |
| 1 | (472,737) | (180,495) | (3,331) | (2,593,409) | (112,622) | (2,469,091) | (153,973) | 1,039,459 | (4,946,197) |
| 2 | (445,978) | (170,278) | (3,142) | (2,446,612) | (106,247) | (2,329,331) | (145,257) | 1,406,095 | (4,240,751) |
| 3 | (420,734) | (160,640) | (2,964) | (2,308,125) | (100,233) | (2,197,482) | (137,035) | 1,727,893 | (3,599,319) |
| 4 | (396,919) | (151,547) | (2,797) | (2,177,476) | (94,559) | (2,073,096) | (129,279) | 2,008,757 | (3,016,915) |
| 5 | (374,452) | (142,969) | (2,638) | (2,054,223) | (89,207) | (1,955,751) | (121,961) | 2,252,289 | (2,488,912) |
| 6 | (353,256) | (134,876) | (2,489) | (1,937,946) | (84,157) | (1,845,048) | (115,057) | 2,461,815 | (2,011,016) |
| 7 | (333,261) | (127,242) | (2,348) | (1,828,251) | (79,394) | (1,740,611) | (108,545) | 2,640,404 | (1,579,247) |
| 8 | (314,397) | (120,039) | (2,215) | (1,724,765) | (74,900) | (1,642,086) | (102,401) | 2,790,889 | (1,189,915) |
| 9 | (296,601) | (113,245) | (2,090) | (1,627,137) | (70,660) | (1,549,138) | (96,604) | 2,915,877 | (839,597) |
| 10 | (279,812) | (106,834) | (1,971) | (1,535,035) | (66,661) | (1,461,451) | (91,136) | 3,017,774 | (525,126) |
| 11 | (263,974) | (100,787) | (1,860) | (1,448,146) | (62,887) | (1,378,727) | (85,978) | 2,954,410 | (387,949) |
| 12 | (249,032) | (95,082) | (1,755) | (1,366,176) | (59,328) | (1,300,686) | (81,111) | 2,888,551 | (264,618) |
| 13 | (234,936) | (89,700) | (1,655) | (1,288,845) | (55,969) | (1,227,062) | (76,520) | 2,820,681 | (154,007) |
| 14 | (221,637) | (84,623) | (1,562) | (1,215,891) | (52,801) | (1,157,606) | (72,188) | 2,751,240 | (55,070) |

CHAPTER 7: EVALUATION OF IMPACTS

| Yr | Loss of Env Services from Mangrove-Direct Use Value | Loss of Env Services from Mangrove-Indirect Use Value | Loss of Env Services from Mangrove-Option/ Non Use Value | Loss in Oil Palm Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Oil Palm Land - Carbon Sequestration | Loss in Rubber Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Rubber Land - Carbon Sequestration | Gain from Reduction in CO ₂ Emission due to Mode Switching | Net Gain/(Loss) in Environmental Services |
|----|---|---|--|---|--|---|--|---|---|
| 15 | (209,092) | (79,833) | (1,473) | (1,147,067) | (49,813) | (1,092,081) | (68,102) | 2,680,622 | 33,161 |
| 16 | (197,257) | (75,314) | (1,390) | (1,082,139) | (46,993) | (1,030,265) | (64,248) | 2,609,184 | 111,579 |
| 17 | (186,091) | (71,051) | (1,311) | (1,020,886) | (44,333) | (971,948) | (60,611) | 2,537,245 | 181,014 |
| 18 | (175,558) | (67,029) | (1,237) | (963,100) | (41,824) | (916,932) | (57,180) | 2,465,090 | 242,230 |
| 19 | (165,620) | (63,235) | (1,167) | (908,585) | (39,456) | (865,031) | (53,943) | 2,392,974 | 295,937 |
| 20 | (156,246) | (59,656) | (1,101) | (857,155) | (37,223) | (816,067) | (50,890) | 2,321,124 | 342,787 |
| 21 | (147,402) | (56,279) | (1,039) | (808,637) | (35,116) | (769,874) | (48,009) | 2,253,073 | 386,717 |
| 22 | (139,058) | (53,093) | (980) | (762,865) | (33,128) | (726,296) | (45,292) | 2,185,288 | 424,575 |
| 23 | (131,187) | (50,088) | (924) | (719,684) | (31,253) | (685,185) | (42,728) | 2,117,958 | 456,908 |
| 24 | (123,761) | (47,253) | (872) | (678,947) | (29,484) | (646,401) | (40,310) | 2,051,249 | 484,221 |
| 25 | (116,756) | (44,578) | (823) | (640,516) | (27,815) | (609,812) | (38,028) | 1,985,306 | 506,978 |
| 26 | (110,147) | (42,055) | (776) | (604,261) | (26,241) | (575,295) | (35,875) | 1,920,257 | 525,607 |
| 27 | (103,912) | (39,675) | (732) | (570,057) | (24,755) | (542,731) | (33,845) | 1,856,210 | 540,503 |
| 28 | (98,030) | (37,429) | (691) | (537,790) | (23,354) | (512,010) | (31,929) | 1,793,261 | 552,028 |
| 29 | (92,482) | (35,310) | (652) | (507,349) | (22,032) | (483,029) | (30,122) | 1,731,492 | 560,517 |
| 30 | (87,247) | (33,311) | (615) | (478,631) | (20,785) | (455,687) | (28,417) | 1,670,969 | 566,276 |

CHAPTER 7: EVALUATION OF IMPACTS

| Yr | Loss of Env Services from Mangrove-Direct Use Value | Loss of Env Services from Mangrove-Indirect Use Value | Loss of Env Services from Mangrove-Option/ Non Use Value | Loss in Oil Palm Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Oil Palm Land - Carbon Sequestration | Loss in Rubber Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Rubber Land - Carbon Sequestration | Gain from Reduction in CO ₂ Emission due to Mode Switching | Net Gain/(Loss) in Environmental Services |
|----|---|---|--|---|--|---|--|---|---|
| 31 | (82,308) | (31,426) | (580) | (451,539) | (19,609) | (429,894) | (26,808) | 1,602,477 | 560,314 |
| 32 | (77,649) | (29,647) | (547) | (425,980) | (18,499) | (405,560) | (25,291) | 1,536,385 | 553,212 |
| 33 | (73,254) | (27,969) | (516) | (401,868) | (17,452) | (382,604) | (23,859) | 1,472,641 | 545,119 |
| 34 | (69,108) | (26,386) | (487) | (379,121) | (16,464) | (360,947) | (22,509) | 1,411,190 | 536,170 |
| 35 | (65,196) | (24,892) | (459) | (357,661) | (15,532) | (340,516) | (21,235) | 1,351,978 | 526,487 |
| 36 | (61,506) | (23,483) | (433) | (337,416) | (14,653) | (321,242) | (20,033) | 1,294,948 | 516,183 |
| 37 | (58,024) | (22,154) | (409) | (318,317) | (13,823) | (303,058) | (18,899) | 1,240,042 | 505,358 |
| 38 | (54,740) | (20,900) | (386) | (300,299) | (13,041) | (285,904) | (17,829) | 1,187,203 | 494,105 |
| 39 | (51,641) | (19,717) | (364) | (283,301) | (12,303) | (269,721) | (16,820) | 1,136,372 | 482,506 |
| 40 | (48,718) | (18,601) | (343) | (267,265) | (11,606) | (254,453) | (15,868) | 1,087,493 | 470,638 |
| 41 | (45,961) | (17,548) | (324) | (252,137) | (10,949) | (240,050) | (14,970) | 1,031,456 | 449,517 |
| 42 | (43,359) | (16,555) | (305) | (237,865) | (10,330) | (226,463) | (14,122) | 978,279 | 429,280 |
| 43 | (40,905) | (15,618) | (288) | (224,401) | (9,745) | (213,644) | (13,323) | 927,817 | 409,894 |
| 44 | (38,589) | (14,734) | (272) | (211,699) | (9,193) | (201,551) | (12,569) | 879,933 | 391,326 |
| 45 | (36,405) | (13,900) | (256) | (199,716) | (8,673) | (190,142) | (11,857) | 834,498 | 373,548 |
| 46 | (34,344) | (13,113) | (242) | (188,411) | (8,182) | (179,380) | (11,186) | 791,386 | 356,528 |

CHAPTER 7: EVALUATION OF IMPACTS

| Yr | Loss of Env Services from Mangrove-Direct Use Value | Loss of Env Services from Mangrove-Indirect Use Value | Loss of Env Services from Mangrove-Option/ Non Use Value | Loss in Oil Palm Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Oil Palm Land - Carbon Sequestration | Loss in Rubber Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Rubber Land - Carbon Sequestration | Gain from Reduction in CO ₂ Emission due to Mode Switching | Net Gain/(Loss) in Environmental Services |
|----|---|---|--|---|--|---|--|---|---|
| 47 | (32,400) | (12,371) | (228) | (177,747) | (7,719) | (169,226) | (10,553) | 750,482 | 340,238 |
| 48 | (30,566) | (11,670) | (215) | (167,685) | (7,282) | (159,647) | (9,956) | 711,673 | 324,650 |
| 49 | (28,836) | (11,010) | (203) | (158,194) | (6,870) | (150,611) | (9,392) | 678,315 | 313,200 |
| PV | (8,372,181) | (3,196,564) | (58,988) | (45,929,342) | (1,994,531) | (43,727,660) | (2,726,864) | 89,775,771 | (16,230,359) |

CHAPTER 7: EVALUATION OF IMPACTS

Table 7-72: Estimates of the Discounted Environmental Cost and Benefit (Discount Rate = 8%)

| Yr | Loss of Env Services from Mangrove-Direct Use Value | Loss of Env Services from Mangrove-Indirect Use Value | Loss of Env Services from Mangrove-Option/Non Use Value | Loss in Oil Palm Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Oil Palm Land - Carbon Sequestration | Loss in Rubber Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Rubber Land - Carbon Sequestration | Gain from Reduction in CO ₂ Emission due to Mode Switching | Net Gain/(Loss) in Environmental Services |
|----|---|---|---|---|--|---|--|---|---|
| 0 | (501,101) | (191,324) | (3,531) | (2,749,014) | (119,379) | (2,617,236) | (163,211) | 623,766 | (5,721,029) |
| 1 | (463,982) | (177,152) | (3,269) | (2,545,383) | (110,536) | (2,423,367) | (151,122) | 1,020,210 | (4,854,600) |
| 2 | (429,613) | (164,030) | (3,027) | (2,356,836) | (102,348) | (2,243,858) | (139,927) | 1,354,499 | (4,085,140) |
| 3 | (397,790) | (151,879) | (2,803) | (2,182,256) | (94,767) | (2,077,646) | (129,562) | 1,633,666 | (3,403,037) |
| 4 | (368,324) | (140,629) | (2,595) | (2,020,607) | (87,747) | (1,923,747) | (119,965) | 1,864,043 | (2,799,572) |
| 5 | (341,041) | (130,212) | (2,403) | (1,870,932) | (81,247) | (1,781,247) | (111,079) | 2,051,325 | (2,266,836) |
| 6 | (315,779) | (120,567) | (2,225) | (1,732,345) | (75,229) | (1,649,303) | (102,851) | 2,200,635 | (1,797,663) |
| 7 | (292,388) | (111,636) | (2,060) | (1,604,023) | (69,656) | (1,527,132) | (95,232) | 2,316,569 | (1,385,558) |
| 8 | (270,729) | (103,367) | (1,907) | (1,485,206) | (64,497) | (1,414,011) | (88,178) | 2,403,252 | (1,024,643) |
| 9 | (250,675) | (95,710) | (1,766) | (1,375,191) | (59,719) | (1,309,270) | (81,646) | 2,464,383 | (709,594) |
| 10 | (232,107) | (88,620) | (1,635) | (1,273,325) | (55,295) | (1,212,287) | (75,598) | 2,503,271 | (435,597) |
| 11 | (214,914) | (82,056) | (1,514) | (1,179,005) | (51,200) | (1,122,488) | (69,999) | 2,405,326 | (315,848) |
| 12 | (198,994) | (75,978) | (1,402) | (1,091,671) | (47,407) | (1,039,340) | (64,813) | 2,308,157 | (211,449) |
| 13 | (184,254) | (70,350) | (1,298) | (1,010,807) | (43,895) | (962,352) | (60,012) | 2,212,185 | (120,784) |
| 14 | (170,605) | (65,138) | (1,202) | (935,932) | (40,644) | (891,067) | (55,567) | 2,117,766 | (42,390) |

CHAPTER 7: EVALUATION OF IMPACTS

| Yr | Loss of Env Services from Mangrove-Direct Use Value | Loss of Env Services from Mangrove-Indirect Use Value | Loss of Env Services from Mangrove-Option/ Non Use Value | Loss in Oil Palm Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Oil Palm Land - Carbon Sequestration | Loss in Rubber Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Rubber Land - Carbon Sequestration | Gain from Reduction in CO ₂ Emission due to Mode Switching | Net Gain/(Loss) in Environmental Services |
|----|---|---|--|---|--|---|--|---|---|
| 15 | (157,968) | (60,313) | (1,113) | (866,604) | (37,633) | (825,062) | (51,451) | 2,025,197 | 25,053 |
| 16 | (146,267) | (55,846) | (1,031) | (802,411) | (34,846) | (763,946) | (47,640) | 1,934,722 | 82,736 |
| 17 | (135,432) | (51,709) | (954) | (742,973) | (32,264) | (707,358) | (44,111) | 1,846,538 | 131,737 |
| 18 | (125,400) | (47,879) | (884) | (687,938) | (29,874) | (654,961) | (40,843) | 1,760,803 | 173,024 |
| 19 | (116,111) | (44,332) | (818) | (636,980) | (27,662) | (606,445) | (37,818) | 1,677,637 | 207,472 |
| 20 | (107,510) | (41,048) | (757) | (589,796) | (25,613) | (561,523) | (35,017) | 1,597,131 | 235,867 |
| 21 | (99,547) | (38,008) | (701) | (546,107) | (23,715) | (519,929) | (32,423) | 1,521,596 | 261,166 |
| 22 | (92,173) | (35,192) | (649) | (505,655) | (21,959) | (481,416) | (30,021) | 1,448,489 | 281,424 |
| 23 | (85,345) | (32,585) | (601) | (468,199) | (20,332) | (445,755) | (27,797) | 1,377,863 | 297,247 |
| 24 | (79,023) | (30,172) | (557) | (433,518) | (18,826) | (412,736) | (25,738) | 1,309,752 | 309,182 |
| 25 | (73,170) | (27,937) | (516) | (401,405) | (17,431) | (382,163) | (23,832) | 1,244,172 | 317,718 |
| 26 | (67,750) | (25,867) | (477) | (371,671) | (16,140) | (353,855) | (22,066) | 1,181,120 | 323,293 |
| 27 | (62,731) | (23,951) | (442) | (344,140) | (14,945) | (327,643) | (20,432) | 1,120,583 | 326,298 |
| 28 | (58,084) | (22,177) | (409) | (318,648) | (13,838) | (303,374) | (18,918) | 1,062,534 | 327,085 |
| 29 | (53,782) | (20,534) | (379) | (295,045) | (12,813) | (280,901) | (17,517) | 1,006,935 | 325,964 |

CHAPTER 7: EVALUATION OF IMPACTS

| Yr | Loss of Env Services from Mangrove-Direct Use Value | Loss of Env Services from Mangrove-Indirect Use Value | Loss of Env Services from Mangrove-Option/Non Use Value | Loss in Oil Palm Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Oil Palm Land - Carbon Sequestration | Loss in Rubber Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Rubber Land - Carbon Sequestration | Gain from Reduction in CO ₂ Emission due to Mode Switching | Net Gain/(Loss) in Environmental Services |
|----|---|---|---|---|--|---|--|---|---|
| 30 | (49,798) | (19,013) | (351) | (273,190) | (11,864) | (260,094) | (16,219) | 953,744 | 323,215 |
| 31 | (46,109) | (17,605) | (325) | (252,953) | (10,985) | (240,828) | (15,018) | 897,712 | 313,889 |
| 32 | (42,694) | (16,301) | (301) | (234,216) | (10,171) | (222,989) | (13,906) | 844,749 | 304,172 |
| 33 | (39,531) | (15,093) | (279) | (216,867) | (9,418) | (206,471) | (12,876) | 794,706 | 294,172 |
| 34 | (36,603) | (13,975) | (258) | (200,803) | (8,720) | (191,177) | (11,922) | 747,442 | 283,984 |
| 35 | (33,892) | (12,940) | (239) | (185,928) | (8,074) | (177,016) | (11,039) | 702,819 | 273,692 |
| 36 | (31,381) | (11,982) | (221) | (172,156) | (7,476) | (163,903) | (10,221) | 660,706 | 263,366 |
| 37 | (29,057) | (11,094) | (205) | (159,404) | (6,922) | (151,762) | (9,464) | 620,975 | 253,068 |
| 38 | (26,904) | (10,272) | (190) | (147,596) | (6,410) | (140,521) | (8,763) | 583,506 | 242,851 |
| 39 | (24,911) | (9,511) | (176) | (136,663) | (5,935) | (130,112) | (8,114) | 548,180 | 232,758 |
| 40 | (23,066) | (8,807) | (163) | (126,540) | (5,495) | (120,474) | (7,513) | 514,886 | 222,829 |
| 41 | (21,358) | (8,154) | (150) | (117,166) | (5,088) | (111,550) | (6,956) | 479,311 | 208,888 |
| 42 | (19,776) | (7,550) | (139) | (108,487) | (4,711) | (103,287) | (6,441) | 446,181 | 195,790 |
| 43 | (18,311) | (6,991) | (129) | (100,451) | (4,362) | (95,636) | (5,964) | 415,330 | 183,486 |
| 44 | (16,954) | (6,473) | (119) | (93,010) | (4,039) | (88,552) | (5,522) | 386,601 | 171,930 |

CHAPTER 7: EVALUATION OF IMPACTS

| Yr | Loss of Env Services from Mangrove-Direct Use Value | Loss of Env Services from Mangrove-Indirect Use Value | Loss of Env Services from Mangrove-Option/Non Use Value | Loss in Oil Palm Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Oil Palm Land - Carbon Sequestration | Loss in Rubber Land - Productivity Net of Net of Non-Environmental Inputs | Loss in Rubber Land - Carbon Sequestration | Gain from Reduction in CO ₂ Emission due to Mode Switching | Net Gain/(Loss) in Environmental Services |
|----|---|---|---|---|--|---|--|---|---|
| 45 | (15,698) | (5,994) | (111) | (86,121) | (3,740) | (81,992) | (5,113) | 359,849 | 161,080 |
| 46 | (14,536) | (5,550) | (102) | (79,741) | (3,463) | (75,919) | (4,734) | 334,939 | 150,894 |
| 47 | (13,459) | (5,139) | (95) | (73,835) | (3,206) | (70,295) | (4,384) | 311,745 | 141,333 |
| 48 | (12,462) | (4,758) | (88) | (68,365) | (2,969) | (65,088) | (4,059) | 290,149 | 132,360 |
| 49 | (11,539) | (4,406) | (81) | (63,301) | (2,749) | (60,267) | (3,758) | 271,428 | 125,327 |
| PV | (6,620,628) | (2,527,808) | (46,647) | (36,320,416) | (1,577,253) | (34,579,350) | (2,156,374) | 62,759,082 | (21,069,393) |

7.18 PRE-CONSTRUCTION STAGE

7.18.1 Surveys, Designs and Studies

The conduct of topographical, geotechnical and utility detection surveys will not cause any significant adverse impacts to be exerted on identified environmental receptors that are located within the Zone of Influence (ZOI). Instead, positive impacts shall materialize because of the following reasons, viz:

- Information garnered shall assist in the design of safe and structurally sound stations, park and ride buildings, piers, guideways, tracking power sub-stations, access roads, etc.
- Topographical and soils surveys shall optimize the Project's alignment foundation designs and minimize site preparation works. In addition these surveys shall eliminate Project's capabilities to damage existing structures. In addition the mentioned surveys will assist in estimating reliable Project costs.
- Utility surveys shall be able to Identify and confirm the exact location of pipelines and cables that lie within or adjacent to the Project's ROW, thus preventing any accidental damage and/or interruption to the services during construction of the Project's facilities such as the planned elevated structure, tunnels etc.
- All activities executed at this stage shall generate both business and employment opportunities, albeit on a relatively low scale.

Generally, on a socio-economic front, net positive impacts will be generated albeit on a moderate scale. This will arise as a consequence of generating employment and business opportunities through engagement of specialist consultants; and in the conduct of topographic, utility and geotechnical surveys. It is concluded that marginal net positive beneficial impacts will be generated over a limited period of time; having both local and regional spatial effects.

Environmental investigations have contributed to positive impacts in that they have provided the means to identify specific control and mitigation measures that are required to be adopted as part and parcel of Project development and operations so as to ensure that adverse impacts on external environmental receptors do not materialize over the Project's lifespan. It provides an opportunity to stipulate mitigation measures which contractors have to abide with, and to pay for, as part of their obligations to the Project Proponent. The EIA study shall also provide an independent consensus, and reconfirm, on the suitability of siting the Project at the proposed locations, i.e. attesting its siting compatibility in relation to surrounding land use, activities and environmental resources and receptors.

7.18.2 Land Acquisition

The Project will require a significant amount of land areas to be acquired prior to commencing with the construction of facilities. In this respect about 2,043 ha of rubber and oil palm plantation land will have to be alienated and acquired. Potential impacts relate to current and future revenue losses from the sales of rubber latex and palm oil fruit bunches.

The route alignment has been selected so as to minimise compulsory purchase of residential and commercial land areas, and associated eviction of land owners. Approximately 3,000 lots of land will be potentially acquired for the Project.

Impacts typically associated with land acquisition include anxiety, severance from community, financial distress and concerns, relocation costs, market impacts (for commercial properties); and operational difficulties (for commercial properties). Given the nature of acquisition required for this Project, physical relocation of households or business premises are expected to occur.

Impacts typically associated with land acquisition include anxiety, severance from community, financial distress and concerns, relocation costs, market impacts (for commercial properties); and operational difficulties (for commercial properties). Given the nature of acquisition required for this Project, physical relocation of households or business premises are to be expected.

CHAPTER 7: EVALUATION OF IMPACTS

Private land will be acquired under the processes established in the Land Acquisition Act, 1960. The First Schedule of the Act allows for the following matters to be considered in determining the amount of compensation to which a private entity is entitled:

- Market value of the land;
- Betterment; i.e. any increase in the value of the remaining land after acquisition (this value is deducted);
- Damage to existing use value of the land caused by severance;
- Damage sustained or potentially sustained to the value of the land caused by any other factors associated with the acquisition;
- Incidental expenses incurred as a result of resettlement of business or dwelling; and/or
- Provision of any benefits accrued by the acquisition to remaining land parcel (if only partially acquired) e.g. through the provision of infrastructure (roads, drains, walls, fences etc).

The extent of compulsory purchase required for this Project has been minimised to the extent possible. Nevertheless, clear compensation provisions and rights will need to be communicated clearly to affected parties early to minimise anxiety and stress.

A detailed assessment and evaluation of the socio-economic impacts associated with the acquisition of land areas, and with the eviction and relocation of commercial businesses and individual residents, are being carried out under a separate **Social Impact Assessment (SIA)** study under the purview of PLANMalayisa. The Terms of Reference (TOR) for SIA has been submitted and endorsed by PLANMalayisa as attached in **Appendix 1A**. The salient findings and conclusions of this Study will be reported in an independent document.

CHAPTER 7: EVALUATION OF IMPACTS

| KUALA LUMPUR - SINGAPORE HIGH SPEED RAIL - IMPACT ASSESSMENT MATRIX FOR TRACK WORK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---------------------|------------------------------|-----------------------------------|-----|---|-----------------|--------------------|------------------|---------------|------------|------------------------------|-----------|----------|--|------------------|-------------------|---------------------------------|-------------------------------|--|---------|---|-------------------------------------|-----------|-----------------------|----------------------|---------------------------------|----------------------|-------------|----------------------------------|------------------------|---|----------------------|-------------------|--------------------------------------|-------------------------------|
| LEGEND: B - Beneficial Impact A - Adverse Impact Degree of Significance: 1 - Low Degree & Short Duration 2 - Low Degree & Long Duration 3 - High Degree & Short Duration 4 - High Degree & Long Duration Blank - Unrelated N - Negligible L - Localized D - Significant Adverse Environmental Impact for which a design solution is identified | | | | | PROJECT ACTIVITIES - TRACK WORK (AT GRADE, ELEVATED, TUNNEL AND BRIDGE) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | PRE-CONSTRUCTION | | | | CONSTRUCTION | | | | | | | | | | | | | | | | OPERATION | | | | | | | | | | |
| | | | | | SURVEY | UTILITY MAPPING | UTILITY RELOCATION | LAND ACQUISITION | LAND CLEARING | DEMOLITION | CONSTRUCTION OF ACCESS ROADS | EARTHWORK | DRAINAGE | /TRANSPORTATION OF MATERIALS EQUIPMENT | VEHICLE MOVEMENT | TRAFFIC DIVERSION | DISPOSAL OF UNSUITABLE MATERIAL | WASTE / WASTEWATER GENERATION | DISPOSAL OF SOLID AND CONSTRUCTION WASTE / BIOMASS | PIILING | CONSTRUCTION OF ELEVATED STRUCTURES BRIDGES / | CONSTRUCTION OF AT-GRADE STRUCTURES | TUNELLING | INSTALLATION OF TRACK | UTILITIES RELOCATION | EMPLOYMENT OF WORKERS AND STAFF | BUSINESS DEVELOPMENT | ABANDONMENT | MOVEMENT OF TRAINS AT HIGH SPEED | DERAILMENT / COLLISION | EMPLOYMENT OF OPERATION AND MAINTENANCE STAFF | BUSINESS DEVELOPMENT | FOOTPRINT OF PIER | REPAIR AND MAINTENANCE WORK ON TRACK | WASTE / WASTEWATER GENERATION |
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | | |
| ENVIRONMENTAL COMPONENTS | PHYSICAL / CHEMICAL | LAND | Landform | | | | | L | L | A2 | A3 | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | Soil Profile | | | | | | | NA2 | NA2 | | | | | | | LA2 | | | LA2 | LA2 | | | | | | | | | | | | | |
| | | | Soil Composition | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | Seismicity | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | Slope Stability | | | | | | LA1 | L | A1 | A3 | | | | | | LA1 | | | | | | | | | | | | | | | | | |
| | | | Subsidence and Compaction | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | Flood Plains / Swamps | | | | | | | | LA2 | LA1 | | | | | | | | | LA2 | | | | | | | | | | | | | | |
| | | | Landuse | N | N | N | N | LA1 | N | LA1 | LA1 | LA1 | N | N | N | LA1 | N | LA1 | N | LA1 | LA1 | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| | | | Engineering and Mineral Resources | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | Buffer Zone | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SURFACE WATER | Shoreline | LB2 | LB2 | N | N | LA1 | LA1 | N | LA1 | LB2 | N | N | N | N | N | N | N | N | N | N | LA1 | N | N | N | N | N | N | N | N | N | N | N | N | |
| | | Bottom Interface | LB1 | LB2 | N | N | N | LA1 | N | LA1 | LB2 | N | N | N | N | N | N | N | N | N | N | LA1 | N | N | N | N | N | N | N | N | N | N | N | N | |
| | | Flow Variation | LB1 | LB2 | N | N | N | N | N | N | LB2 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | |
| | | Water Quality | LA1 | LA1 | LA1 | | LA3 | LA3 | LA3 | LA3 | LA3 | LA1 | LA1 | | L2A | LA4 | LA4 | LA1 | LA1 | DA3 | LA3 | N | LA1 | LB1 | LB1 | LA4 | | | | | | | | | |
| | | Drainage Pattern | LB2 | LB2 | N | N | N | N | N | LA1 | LB2 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | |
| | | Water Balance | LB2 | LB2 | N | N | LA1 | N | N | LA1 | LA1 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | |
| | | Flooding | LB2 | LB2 | N | N | LA1 | N | N | LA1 | LB2 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | |
| | | Existing Use | LB2 | LB2 | N | N | LA1 | N | N | LA1 | LB2 | N | N | N | N | N | N | N | N | N | LA1 | LA1 | N | N | N | N | N | N | N | N | N | N | N | N | |
| | MARINE WATER | Water Quality | | | | | | | | | LA1 | | | | | LA1 | | | LA1 | | | | | | | | | | | | | N | LA1 | | |
| | | -Suspended sediment plume | | | | | | | | | | | | | | | | N | | | | | | | | | | | | | | | | | |
| | | Current Speed | | | | | | | | | | | | | | | | LA1 | | | | | | | | | | | | | | | | | |
| | | Sedimentation/ Erosion | | | | | | | | | | | | | | | | | | | | | | | | | | | | | LA2 | N | | | |
| | | Water Level | | | | | | | | | | | | | | | | | | | | | | | | | | | | | N | | | | |
| | | Current Flow | | | | | | | | | | | | | | | | | | | | | | | | | | | | | N | | | | |
| | | Wave | | | | | | | | | | | | | | | | | | | | | | | | | | | | | N | | | | |
| | GROUND WATER | Water Table | | | | | | | | | | | | | | | | | | | LA1 | | | | | | | | | | | | | | |
| | | Flow Regime | | | | | | | | NA1 | | | | | | | | | | LA2 | LA2 | | | | | | | | | | | | | | |
| | | Water Quality | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | LA2 | |
| | | Recharge | | | | | | | | | NB1 | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Aquifer Characteristic | | | | | | | | NA1 | | | | | | | | | NA2 | | | | | | | | | | | | | | | | |
| | Existing Use | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | TRAFFIC | Land | LB1 | LB1 | LB1 | LB1 | | LB1 | LB1 | LB1 | LB2 | LB1 | LB1 | LB1 | LB1 | LB1 | LB1 | LB1 | LB1 | LB2 | LB1 | LB1 | LB1 | LB1 | LB1 | LA1 | | LB1 | LA4 | LB1 | LB1 | | LB1 | LB1 | LB1 |
| | | Marine Navigation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | - Increase in marine traffic | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ATMOSPHERE | Air Quality | | | | | | L1 | L1 | L3 | L1 | L1 | L1 | L1 | L1 | | N | N | L1 | L1 | L1 | N | | | | N | | N | | | | | N | | N |
| | | Air Flow | | | | | | N | N | N | N | N | N | N | N | | N | N | N | N | N | N | | | | N | | N | | | | | N | | N |
| | | Visibility | | | | | | N | N | N | N | N | N | N | N | | N | N | N | N | N | N | | | | N | | N | | | | | N | | N |
| | | Climate Changes | | | | | | N | N | N | N | N | N | N | N | | N | N | N | N | N | N | | | | N | | N | | | | | N | | N |
| | NOISE & VIBRATION | Intensity | | | | | | | A1L | | | | | | | | | | A2L | A1L | A2L | A1L | | | | | | | | | | | | | |
| | | Duration | | | | | | A1L | A1L | A1L | A1L | | A1L | A1L | A2L | | | | A2L | A1L | A2L | A1L | A1L | A2L | | | | | | | | A1L | | | |
| | | Frequency | | | | | | A1L | A1L | A1L | A1L | | A1L | A1L | A2L | | | | A2L | A1L | A2L | A1L | A1L | A2L | | | | | | | | A1L | | | |
| | BIOLOGICAL | SPECIES & POPULATION | Terrestrial Vegetation | N | - | N | - | A3LD | A2L | A1L | A3D | A1N | A1N | - | - | A1N | - | A3L | A1N | A2L | A1L | A1L | A1L | A1L | A1L | - | - | - | - | - | - | - | - | - | |
| | | | Terrestrial Wildlife | N | - | N | - | A3LD | A2L | A1L | A3D | A1N | A1N | - | - | A1N | - | A3L | A1N | A2L | A1L | A1L | A1L | A1L | A1L | - | - | - | - | - | - | - | - | - | |
| | | | Other Terrestrial Fauna | N | - | N | - | A3LD | A2L | A1L | A3D | A1N | A1N | - | - | A1N | - | A3L | A1N | A2L | A1L | A1L | A1L | A1L | A1L | - | - | - | - | - | - | - | - | - | |
| | | HABITATS & COMMUNITIES | Terrestrial Habitats | N | - | N | | A3LD | A2L | A1L | A3D | A1N | A1N | - | - | A1N | - | A2L | A1N | A2L | A1L | A1L | A1L | A1L | A1L | A1L | - | - | - | | | | | | |
| | | | Terrestrial Communities | N | - | N | | A3LD | A2L | A1L | A3D | A1N | A1N | - | - | A1N | - | A2L | A1N | A2L | A1L | A1L | A1L | A1L | A1L | A1L | - | - | - | | | | | | |
| | | | Estuarine Habitats | N | - | N | | A3LD | A2L | A1L | A3D | A1N | A1N | - | - | A1N | - | A2L | A1N | A2L | A1L | A1L | A1L | A1L | A1L | A1L | - | - | - | | | | | | |
| | | | Estuarine Communities | N | - | N | | A3LD | A2L | A1L | A3D | A1N | A1N | - | - | A1N | - | A2L | A1N | A2L | A1L | A1L | A1L | A1L | A1L | A1L | - | - | - | | | | | | |
| | | | Marine Communities | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | Plankton | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | Macrobenthos | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | - Suspended Sediment Plume | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | - Sedimentation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | - Loss of Community and Habitat | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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CHAPTER 8



MITIGATION MEASURES



8.1 INTRODUCTION

The principal impacts which the HSR Project could induce on environmental and other receptors located in the vicinity of its alignment have been identified and thereafter assessed as to their capability to interact adversely or beneficially with local and regional environmental receptors. The findings have been described in Chapter 7. The assessment took into consideration the capability of pollution control systems and environmental protection strategies that are planned to be incorporated in plant design and operations to mitigate potential adverse impacts. The broad range of pollution control systems to be integrated into facility operations were discussed in Chapter 5.

The approach taken in this Chapter is to assess the applicability and reliability of proposed mitigation measures to be advocated for each identified HSR Project activity, and thereby to ascertain whether they are comprehensive and complete, or require additional or further amelioration measures to ensure tolerable impacts on identified local and regional environmental receptors.

This Chapter also identifies and describes measures which are capable of effectively mitigating adverse impacts, as well as enhancing the potential of beneficial impacts, based on proven applications. The probable scope and intensity of residual impacts that remain after appropriate mitigation and control measures are adopted are described, and their implications discussed in the following Chapter, i.e. Chapter 9.

8.2 AIR QUALITY

8.2.1 Construction Phase

The potential for dust dispersions from earthworks operations during the HSR Project's construction phase is moderate, and the resulting impacts on external receptors being localised and temporary. However, should suspended particulate matter (PM_{10}) levels rise above acceptable levels at all construction sites, the following mitigation measures should be taken:

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- Soil loads on construction vehicles shall be kept covered during transit on public roads;
- Topsoil stockpiles shall be kept covered or have a suitable dust palliative such as wet suppression with water sprinklers and water browsers applied;
- Wet suppression shall be applied to unsealed roads if suspended particulate matter (monitored at the approved monitoring stations) rises above the Malaysian Ambient Air Quality Guideline limits for PM₁₀;
- Particulate matter deposition monitoring shall be conducted in accordance with recommended sampling methods.
- All construction vehicles and machinery shall be regularly serviced and maintained to ensure good working condition, thereby reducing the possibility of excessive exhaust emissions.
- Regular spraying and sweeping at the entrance and exit points of construction sites should be conducted. Partially vegetated land surfaces, and temporary stockpiled excavated soils are to be watered / wetted in order to minimize dust dispersions (i.e. negate adverse air quality impacts).
- Construction of 2 m high hoardings around the Project sites wherever feasible.
- It should be made mandatory for the Contractor to abstain from burning waste material at the Project Sites, or at off-site disposal areas, unless a contravening license is obtained from the relevant authorities. Adherence to this practice shall ensure that adverse episodes related to fire hazards and dust/soot/toxic gas emission and dispersion do not materialize; and thereby impact adversely on surrounding areas and construction workers.
- A requirement that construction vehicles to go through washing bays within the site before exiting is recommended.
- Raw materials such as sand, gravel and cement should be stored neatly and covered properly to reduce atmospheric dispersion of these materials.

Traffic controls such as speed limits and traffic volume restrictions to reduce dust churned up by vehicles should be implemented. The recommended speed is not to exceed 30 km/h along haulage roads. Lorries should not be loaded higher than the side tail boards. If possible, transport of earth and construction materials should be confined to non-peak hours of between 10.00 am and 3.00 pm especially in urban areas. Construction roads should also preferably be at least 100 m from dwellings.

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Construction areas should be fenced and boarded to reduce wind-blown dust dispersion and formation of dust clouds.

Installation and operation of portable generator sets or other air pollutant emitting equipment should comply with the requirements of Environmental Quality (Clean Air) Regulations 2014.

No burning of construction wastes should be permitted within the HSR Project sites, nor at disposal sites without the permission of the DOE and/or Local Authorities.

Adequate crusher run vehicular access pathways should be placed where site preparation and excavation works are to be carried out to construct At-Grade guideways, stations, depots and maintenance bases. These pathways established within the construction sites are required to be wetted regularly to minimize fugitive dust dispersions.

In a worst case scenario when dust control measures are inadequate and during unfavourable meteorological conditions such as a prolonged dry spell, sensitive receptors which are located close to significant dust sources should be avoided if the source is from traffic movements. In the case of stationary sources, back up mitigation measures such as reducing the amount of construction activity is recommended.

8.2.2 Operational Phase

Adverse air quality impacts induced by the HSR Project during the operational phase are expected to be negligible and mitigation measures are not required.

It is predicted that positive impacts can be achieved by the operations of the HSR Project, in that the overall carbon dioxide emissions by all modes of transportation between FT. Kuala Lumpur and Singapore will be reduced significantly once the HSR begins operations. This positive impact should be enhanced by adopting the following measures, viz: (a) entice more commuters to shift their mode of travel from cars/buses, airlines and low speed trains to the HSR service by proving effectiveness and efficiency of travel, and establishing competitive fares; (b) improve operational efficiencies; and (c) make maximum use of regenerative breaking opportunities to recycle energy and thereby lower electricity consumptions.

8.3 NOISE AND VIBRATION

8.3.1 Noise

8.3.1.1 Construction Phase

In Chapter 7 an assessment of the potential impacts which the following Project activities could induce on surrounding receptors were discussed, viz:

FT. Kuala Lumpur

- I. Noise from Land Preparation, Earthworks and Demolition Activities
- II. Noise induced by Vehicle Movements and Transportation of Materials and Equipment
- III. Noise from Construction of Access Roads
- IV. Noise from Piling Activities
- V. Noise from Construction of Stations, Depots and Maintenance Bases
- VI. Noise from Construction of Elevated Structures and Bridges
- VII. Noise from Tunnelling
- VIII. Noise from Installation of Tracks
- IX. Noise from Utilities Relocation

Selangor / FT. Putrajaya

- I. Noise from Land Preparation, Earthworks and Demolition Activities
- II. Noise induced by Vehicle Movements and Transportation of Materials and Equipment
- III. Noise from Construction of Access Roads
- IV. Noise from Traffic Diversions
- V. Noise from Piling Activities
- VI. Noise from Construction of Stations, Depots and Maintenance Bases
- VII. Noise from Construction of Elevated Structures and Bridges
- VIII. Noise from Construction of At-grade Structures
- IX. Noise from Tunnelling
- X. Noise from Installation of Tracks
- XI. Noise from Utilities Relocation

Negeri Sembilan

- I. Noise from Land Preparation, Earthworks and Demolition Activities
- II. Noise induced by Vehicle Movements and Transportation of Materials and Equipment
- III. Noise from Construction of Access Roads
- IV. Noise from Traffic Diversions
- V. Noise from Piling Activities
- VI. Noise from Construction of Elevated Structures and Bridges
- VII. Noise from Tunnelling
- VIII. Noise from Installation of Tracks
- IX. Noise from Utilities Relocation

Melaka

- I. Noise from Land Preparation, Earthworks and Demolition Activities
- II. Noise induced by Vehicle Movements and Transportation of Materials and Equipment
- III. Noise from Construction of Access Roads
- IV. Noise from Traffic Diversions
- V. Noise from Piling Activities
- VI. Noise from Construction of Stations, Depots and Maintenance Bases
- VII. Noise from Construction of Elevated Structures and Bridges
- VIII. Noise from Construction of At-grade Structures
- IX. Noise from Installation of Tracks
- X. Noise from Utilities Relocation

Johor

- I. Noise from Land Preparation, Earthworks and Demolition Activities
- II. Noise induced by Vehicle Movements and Transportation of Materials and Equipment
- III. Noise from Construction of Access Roads
- IV. Noise from Traffic Diversions
- V. Noise from Piling Activities
- VI. Noise from Construction of Stations, Depots and Maintenance Bases
- VII. Noise from Construction of Elevated Structures and Bridges
- VIII. Noise from Construction of At-grade Structures

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- IX. Noise from Tunnelling
- X. Noise from Installation of Tracks
- XI. Noise from Utilities Relocation

The findings indicated that for certain activities carried out, the resulting impacts exerted on receptors could induce significant adverse perturbations for which mitigation measures are needed to be adopted in order to reduce the intensity of impacts to tolerable levels. The nature and scope of recommended measures are presented herewith.

A. Noise from Land Preparation, Earthworks and Demolition Activities

- I. Noise-emitting construction activities at the construction site should be restricted to day-time (7.00 a.m. – 7.00 p.m.) and working days only when working close to noise sensitive receptors and residential areas. Subject to restriction by local authority, intensity of noise-emitting activities should be reduced in the evening (7.00 p.m. – 10.00 p.m.) so that the generated sound level is maintained below the limits stipulated in **Table 7-4**. No construction activities are to be performed at night (10.00 p.m. – 7.00 a.m.) which are close to nearest residents and noise sensitive receptors unless with approval from the DOE and/or local authorities.
- II. Approval of any use of explosives for demolition must be obtained from local authorities, whereby its use should be restricted to working days and during day time (7.00 a.m. – 7.00 p.m.) when working close to nearest residents and noise sensitive receptors. Affected residents should be informed of the expected duration of particular noise-emitting activities in order to minimise complaints.
- III. Noise-emitting machinery and equipment used for land preparation, earthworks and demolition activities must be checked for proper installation of noise control devices such as mufflers and soundproof enclosures to reduce noise emission.

B. Noise induced by Vehicle Movements and Transportation of Materials and Equipment

- I. Vehicle frequency and movement to and from the construction sites which generate high noise should be reduced when operating outside working hours and during the weekends and public holidays and when passing close to noise sensitive receptors and residential areas.
- II. Noise-emitting vehicles used for transportation of materials and equipment must be checked for proper installation of noise control devices such as mufflers and soundproof enclosures to reduce noise emission.

C. Noise from Construction of Access Roads

- I. Noise-emitting machinery, equipment and vehicles used for construction of access roads must be checked for proper installation of noise control devices such as mufflers and soundproof enclosures to reduce noise emission.

D. Noise from Traffic Diversions

- I. Temporary noise barriers or noise panels should be erected if the diverted traffic is too close to noise sensitive receptors or residential areas.

E. Noise from Piling Activities

- I. Construction of the elevated tracks, bridges, stations, depots and maintenance bases should employ more silent and low-vibration piling methods such as bored piling, hydraulic press-in or jack-in spun piling when working close to noise sensitive receptors and residential areas.
- II. Noise-emitting construction activities at the construction site should be restricted to day-time (7.00 a.m. – 7.00 p.m.) and working days only when working close to noise sensitive receptors and residential areas. Subject to restriction by local authority, intensity of noise-emitting activities should be reduced in the evening (7.00 p.m. – 10.00 p.m.) so that the generated sound level is maintained below the limits stipulated in **Table 7-4**. No construction activities are to be performed at night (10.00 p.m. – 7.00 a.m.) in areas close to nearest residents and noise sensitive receptors without approval from the DOE and/or local authorities.
- III. Noise-emitting machinery and equipment used for piling must be checked for proper installation of noise control devices such as mufflers and soundproof enclosures to reduce noise emission.

F. Noise from Construction of Stations, Depots and Maintenance Bases

- I. Construction of the stations, depots and maintenance bases should employ more silent and low-vibration piling methods such as bored piling, hydraulic press-in or jack-in spun piling when working close to noise sensitive receptors and residential areas.
- II. Noise-emitting construction activities at the construction site should be restricted to day-time (7.00 a.m. – 7.00 p.m.) and working days only when working close to noise sensitive receptors and residential areas. Subject to restriction by local authority, intensity of noise-emitting activities should be reduced in the evening

(7.00 p.m. – 10.00 p.m.) so that the generated sound level is maintained below the limits stipulated in **Table 7-4**. No construction activities are to be performed at night (10.00 p.m. – 7.00 a.m.) in areas close to nearest residents and noise sensitive receptors without approval from the DOE and/or local authorities.

- III. Noise-emitting machinery and equipment used for construction of stations, depots and maintenance bases must be checked for proper installation of noise control devices such as mufflers and soundproof enclosures to reduce noise emission.

G. Noise from Construction of Elevated Structures and Bridges

- I. Construction of the elevated structures and bridges should employ more silent and low-vibration piling methods such as bored piling, hydraulic press-in or jack-in spun piling when working close to noise sensitive receptors and residential areas.
- II. Noise-emitting construction activities at the construction site should be restricted to day-time (7.00 a.m. – 7.00 p.m.) and working days only when working close to noise sensitive receptors and residential areas. Subject to restriction by local authority, intensity of noise-emitting activities should be reduced in the evening (7.00 p.m. – 10.00 p.m.) so that the generated sound level is maintained below the limits stipulated in **Table 7-4**. No construction activities are to be performed at night (10.00 p.m. – 7.00 a.m.) in areas close to nearest residents and noise sensitive receptors without approval from the DOE and/or local authorities.
- III. Noise-emitting machinery and equipment used for construction of elevated structures and bridges must be checked for proper installation of noise control devices such as mufflers and soundproof enclosures to reduce noise emission.

H. Noise from Construction of At-grade Structures

- I. Noise-emitting construction activities at the construction site should be restricted to day-time (7.00 a.m. – 7.00 p.m.) and working days only when working close to noise sensitive receptors and residential areas. Subject to restriction by local authority, intensity of noise-emitting activities should be reduced in the evening (7.00 p.m. – 10.00 p.m.) so that the generated sound level is maintained below the limits stipulated in **Table 7-4**. No construction activities are to be performed at night (10.00 p.m. – 7.00 a.m.) in areas close to nearest residents and noise sensitive receptors without approval from the DOE and/or local authorities.

- II. Noise-emitting machinery and equipment used for construction of At-Grade structures must be checked for proper installation of noise control devices such as mufflers and soundproof enclosures to reduce noise emission.

I. Noise from Tunnelling

- I. Noise-emitting construction activities at the construction site should be restricted to day-time (7.00 a.m. – 7.00 p.m.) and working days only when working close to noise sensitive receptors and residential areas. Subject to restriction by local authority, intensity of noise-emitting activities should be reduced in the evening (7.00 p.m. – 10.00 p.m.) so that the generated sound level is maintained below the limits stipulated in **Table 7-4**. No construction activities are to be performed at night (10.00 p.m. – 7.00 a.m.) in areas close to nearest residents and noise sensitive receptors without approval from the DOE and/or local authorities.
- II. If NATM is used for construction of tunnel, approval of any use of explosives for demolition must be obtained from local authorities, whereby its use should be restricted to working days and during day time (7.00 a.m. – 7.00 p.m.) when working close to nearest residents and noise sensitive receptors. Affected residents should be informed of the expected duration of particular noise-emitting activities in order to minimise complaints.
- III. Noise-emitting machinery and equipment used for tunnelling must be checked for proper installation of noise control devices such as mufflers and soundproof enclosures to reduce noise emission.

J. Noise from Installation of Tracks

- I. Noise-emitting construction activities at the construction site should be restricted to day-time (7.00 a.m. – 7.00 p.m.) and working days only when working close to noise sensitive receptors and residential areas. Subject to restriction by local authority, intensity of noise-emitting activities should be reduced in the evening (7.00 p.m. – 10.00 p.m.) so that the generated sound level is maintained below the limits stipulated in **Table 7-4**. No construction activities are to be performed at night (10.00 p.m. – 7.00 a.m.) in areas close to nearest residents and noise sensitive receptors without approval from the DOE and/or local authorities.
- II. Noise-emitting machinery and equipment used for installation of tracks must be checked for proper installation of noise control devices such as mufflers and soundproof enclosures to reduce noise emission.

K. Noise from Utilities Relocation

- I. Vehicle frequency and movement to and from the construction sites which generate high noise should be reduced when operating outside working hours and during the weekends and public holidays and when passing close to noise sensitive receptors and residential areas.
- II. Noise-emitting machinery and equipment used for utilities relocation must be checked for proper installation of noise control devices such as mufflers and soundproof enclosures to reduce noise emission.

The mitigation measures recommended in **Section 8.3.1.1(A-K)** above are in line with BS 5228-1:2009 (Code of practice for noise and vibration control on construction and open sites – Part 1: Noise) such as restriction on working hours, installation of equipment silencer, equipment closure, selection of piling method, trenches construction and proper equipment maintenance. Hence, it is recommended that the construction activities follow the code of practice as stipulated by BS 5228-1:2009, which covers the need for protection against noise and vibration of persons living and working in the vicinity of construction and open sites. The standard recommends procedures for noise and vibration control in respect of construction operations and aims to assist architects, contractors and site operatives, designers, developers, engineers, local authority environmental health officers and planners.

In controlling noise transmission to adjacent residential abodes, a noise barrier is the most popular method. A noise barrier is an obstacle placed between source and receiver that interrupts the path of noise. A properly constructed barrier can reduce outdoor noise levels by about 5 to 10 dBA. To be effective, the barrier must block the 'line of sight' between the noise source and the receiver and must be continuous and solid without any opening. Barriers may be provided in the form of earth mounds or fences made of various rigid materials such as concrete blocks and timber. It is recommended that the Project Proponent conduct detailed noise propagation study during detailed design to study the feasibility of constructing a 3 m (provides noise reduction of approximately 13.5 dB) high perimeter wall / hoarding made from rigid material surrounding the Project Site at critical locations (when construction sites are located adjacent to urban developments or rural villages) in the early phase of the construction period. It is recommended that temporary hoarding be erected at locations along the alignment that are less than 30m from the HSR alignment, stations, depots and maintenance bases. However, the eventual need for temporary barriers at these

locations depends on the intensity of construction activities at the respective areas and can only be finalized during the detailed design and pre-construction stage.

Continuous noise monitoring is recommended during the construction phase. All complaints from any interested party must be investigated and remedial/control measures implemented.

Other Considerations

In order to check for proper installation and effectiveness of noise control devices onto vehicles transporting construction materials and construction machinery and equipment such as mufflers and soundproof enclosures, the device should reduce the sound pressure level to a maximum of 85 dBA at one metre from the noise source as stipulated by the Factories and Machinery (Noise Exposure) Regulations 1989. By doing so, the cumulative sound pressure level can be ensured to be below the limits stipulated by in **Chapter 7** at a distance 25-30 m or a buffer zone of similar length from the construction sites with 6-10 vehicles and construction machines operating at the same time. If the level cannot be reduced, the temporary noise barriers or noise panels are required so that the noise level during construction is below the stipulated limits at nearest noise sensitive receptors and residential areas.

8.3.1.2 Operational Phase

In Chapter 7 an assessment of the potential impacts which the following Project activities could induce on surrounding Receptors were discussed, viz:

FT. Kuala Lumpur

- I. Noise from movement of trains at high speed and approaching/leaving stations.
- II. Noise due to Activities at Stations

Selangor / FT. Putrajaya

- I. Noise from movement of trains at high speed and approaching/leaving stations .
- II. Noise due to Activities at Stations, Depots and Maintenance Bases and Repair and Maintenance Work on Tracks
- III. Noise from Road Traffic Flow

Negeri Sembilan

- I. Noise from movement of trains at high speed and approaching/leaving stations
- II. Noise due to Activities at Stations

Melaka

- I. Noise from movement of trains at high speed and approaching/leaving stations
- II. Noise due to Activities at Stations

Johor

- I. Noise from movement of trains at high speed and approaching/leaving stations
- II. Noise from Road Traffic Flow
- III. Noise due to Activities at Stations, Depots and Maintenance Bases and Repair and Maintenance Work on Tracks

The findings indicated that for certain activities carried out, the resulting impacts exerted on receptors could induce significant adverse perturbations for which mitigation and abatement (M&A) measures were needed to be instituted in order to reduce the intensity of impacts to tolerable levels. The nature and scope of the required M&A measures are presented herewith.

A. Movement of Trains at High Speed and When Approaching/Leaving Stations

- I. A number of residents and other noise sensitive receptors located within 70 meters and 360 meters from the HSR alignment will experience high sound levels (above 65 dB) every day between the hours of 6.00 a.m. to 12.00 a.m. The sound levels will be induced by the frequent passage of trains (several times in an hour) at high speeds (up to 320 km/hr). Effective noise barriers need to be erected alongside the tracks to quell the intensity of transmitted sounds to tolerable levels at the Receptor positions. Noise barriers are recommended to be erected as mitigating measures in all States. The recommended noise barrier locations along the HSR alignment for year 2030 and 2060 is listed in **Table 8-1**. The recommended noise barrier locations are not exhaustive and will be further assessed and determined during the detailed design stage.

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The type, height and materials of noise barriers that will be effective depends on the type of tracks constructed (i.e. At-Grade or on elevated structure), ground topography and environmental conditions prevailing within the surrounding areas. The assessment and implementation of mitigation measures could be reviewed again when speed profiles and final alignment are developed during the detailed design stage.

In addition, particular aerodynamic designs of the train nose and pantograph, as well as the whole train configuration, can reduce noise emission levels. Sonic booms associated with tunnel outlets can be effectively moderated with suitable portal designs that effectively break up micro-pressure waves.

Table 8-1: Locations of Recommend Noise Barriers

| No. | Recommended Location of Noise Barriers [with segment as shown in Appendix 7F] | Sampling Station | Year to Be Required | |
|--------------------|--|---------------------|---------------------|------|
| | | | 2030 | 2060 |
| KUALA LUMPUR | | | | |
| 1. | Bandar Malaysia Station [K01] | NK1 | ✕ | ✕ |
| 2. | Jalan JKR Salak Selatan [K02] | NK2 | ✕ | ✕ |
| 3. | Kg. Baru Salak Selatan [K03] | NK3 | ✕ | ✓ |
| SELANGOR/PUTRAJAYA | | | | |
| 4. | Jalan UPM, Serdang [S01-S03] | NS4 | ✕ | ✓ |
| 5. | Jalan UPM-Jalan Sungai Besi Junction [S04] | - | ✕ | ✕ |
| 6. | Universiti Putra Malaysia (near Jalan Sungai Besi) [S05] | NS5 | ✓ | ✓ |
| 7. | Universiti Tenaga Nasional (near SILK Highway) [S06] | NS6 | ✓ | ✓ |
| 8. | Jalan Ayer Hitam [S07-S08] | - | ✓ | ✓ |
| 9. | Kg. Dato' Abu Bakar Baginda [S09-S10] | NS7 | ✓ | ✓ |
| 10. | Kg. Sungai Merab Luar [S11-S12] | NS8 | ✕ | ✓ |
| 11. | Kg. Sungai Merab Hulu [S13-S15] | NS9 | ✓ | ✓ |
| 12. | Kg. Bukit Piatu, Sepang [S16] | - | ✓ | ✓ |
| 13. | Kg. Jenderam Hulu, Sepang [S17-S19] | - | ✓ | ✓ |
| 14. | Persiaran Vista, Sepang [S20-S22] | NS10 | ✓ | ✓ |
| 15. | Bandar Baru Salak Tinggi [S23-S24] | - | ✕ | ✕ |
| 16. | Desa Bestari, Sepang [S25-S27] | NS11 | ✓ | ✓ |

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| No. | Recommended Location of Noise Barriers [with segment as shown in Appendix 7F] | Sampling Station | Year to Be Required | |
|-----------------|--|---------------------|---------------------|------|
| | | | 2030 | 2060 |
| NEGERI SEMBILAN | | | | |
| 17. | Desa Cempaka, Nilai [N01] | - | ✓ | ✓ |
| 18. | Kolej Ilmu PNB & KPJ University College, Kota Seriemas [N02] | - | ✓ | ✓ |
| 19. | Taman Gadong Putra, Labu [N03] | NN2 | ✓ | ✓ |
| 20. | Taman Cermat Impian, Labu [N04] | - | ✓ | ✓ |
| 21. | Felda Sendayan [N05-N06] | NN4 | ✓ | ✓ |
| 22. | Kg. Sungai Sendayan Dua [N07] | - | ✓ | ✓ |
| 23. | Kg. Siliau, Rantau [N08] | NN5 | ✓ | ✓ |
| 24. | Ladang Siliau [N09] | NN6 | ✗ | ✗ |
| 25. | Taman Sungai Ujong [N10] | NN7 | ✓ | ✓ |
| MELAKA | | | | |
| 26. | Genting Cheng Estate, Bukit Cempedak [M01] | NM1 | ✗ | ✗ |
| 27. | IKBN Alor Gajah, Melaka [M02] | NM2 | ✓ | ✓ |
| 28. | Kg. Air Limau, Masjid Tanah [M03-M04] | NM3 | ✓ | ✓ |
| 29. | Kg. Durian Daun, Masjid Tanah [M05] | NM4 | ✓ | ✓ |
| 30. | Jalan Damai, Melaka [M06] | - | ✓ | ✓ |
| 31. | Taman Paya Rumput Indah [M07-M08] | NM5 | ✓ | ✓ |
| 32. | Taman Satu Krubong [M09-M10] | NM6 | ✓ | ✓ |
| 33. | Kg. Sungai Badau, Krubong [M11] | - | ✗ | ✓ |
| 34. | Kg. Harmoni Belimbing Dalam [M12] | - | ✓ | ✓ |
| 35. | Kg. Bukit Balai, Durian Tunggal [M13] | NM7 | ✓ | ✓ |
| 36. | Kg. Baru Baru Balai, Durian Tunggal [M14] | - | ✓ | ✓ |
| 37. | Kolej Yayasan Saad, Bemban [M15] | NM9 | ✗ | ✗ |
| 38. | Pusat Rehabilitasi Perkeso Melaka [M16] | NM10 | ✓ | ✓ |
| 39. | Kg. Ulu Duyung [M17] | NM11 | ✓ | ✓ |
| 40. | Taman Bemban Jaya [M18] | - | ✓ | ✓ |
| 41. | Taman Bemban Baru [M19-M20] | NM12 | ✓ | ✓ |
| JOHOR | | | | |
| 42. | Jalan Serom 4, Bukit Mati [J01] | NJ1 | ✓ | ✓ |
| 43. | Jalan Bukit Gambir [J02] | NJ2 | ✓ | ✓ |
| 44. | Kg. Meranti Sundai, Bukit Gambir [J03-J04] | - | ✓ | ✓ |

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| No. | Recommended Location of Noise Barriers [with segment as shown in Appendix 7F] | Sampling Station | Year to Be Required | |
|-----|--|---------------------|---------------------|------|
| | | | 2030 | 2060 |
| 45. | Jalan Parit Jarom Laut, Bukit Gambir [J05] | - | ✓ | ✓ |
| 46. | Kg. Sungai Alai, Panchor [J06] | - | ✓ | ✓ |
| 47. | Kg. Jawa, Panchor [J07-J08] | - | ✓ | ✓ |
| 48. | Jalan Kampung Raja, Pagoh [J09-J10] | - | ✓ | ✓ |
| 49. | Jalan Kampung Bukit Panjang, Pagoh [J11] | - | ✓ | ✓ |
| 50. | Jalan Muar-Labis, Pagoh [J12-J13] | NJ4 | ✓ | ✓ |
| 51. | Kg. Air Putih, Parit Sulong [J14-J16] | NJ5 | ✓ | ✓ |
| 52. | Jalan Kampung Air Putih, Parit Sulong [J17] | - | ✓ | ✓ |
| 53. | Kg. Parit Ju, Seri Medan [J18] | - | ✓ | ✓ |
| 54. | Kg. Parit Baharu, Seri Medan [J19-J20] | - | ✓ | ✓ |
| 55. | Jalan Kampung Parit Basri Darat, Seri Medan [J21] | - | ✓ | ✓ |
| 56. | Jalan Pasir, Seri Medan [J22] | NJ6 | ✓ | ✓ |
| 57. | Jalan Kampung Parit Yaani Tengah [J23] | NJ7 | ✓ | ✓ |
| 58. | Jalan Seri Bengkal, Sri Gading [J24-J26] | - | ✓ | ✓ |
| 59. | Taman Gading Emas [J27] | - | ✓ | ✓ |
| 60. | Kg. Parit Sayang, Senggarang [J28] | - | ✓ | ✓ |
| 61. | Kg. Parit Kaseh, Senggarang [J29] | - | ✓ | ✓ |
| 62. | Jalan Kampung Seri Menanti Laut [J30] | N9 | ✓ | ✓ |
| 63. | Jalan Kampung Seri Menanti Darat [J31] | - | ✓ | ✓ |
| 64. | Jalan Kampung Parit Lapis Kadir Darat [J32] | NJ10 | ✓ | ✓ |
| 65. | Jalan Kampung Parit Simpang Empat [J33] | - | ✓ | ✓ |
| 66. | Taman Bayu, Jalan Parit Ismail [J34-J35] | NJ11 | ✓ | ✓ |
| 67. | Jalan Kampung Melayu Raya, Pekan Nanas [J36] | NJ13 | ✓ | ✓ |
| 68. | Jalan Sawah, Pekan Nanas [J37] | NJ14 | ✓ | ✓ |
| 69. | Jalan Utama 24, Pekan Nanas [J38] | NJ15 | ✓ | ✓ |
| 70. | Kg. Melayu, Gelang Patah [J39-J40] | N18 | ✓ | ✓ |
| 71. | Kg. Paya Mengkuang [J41] | NJ19 | ✗ | ✗ |
| 72. | Kg. Tanjung Kupang, Gelang Patah [J42] | NJ20 | ✓ | ✓ |

Note: The proposed noise barrier locations are not exhaustive and to be further assessed and evaluated during detailed design.

B. Road Traffic Flows

- I. Nearby residents and noise sensitive recipients should be informed of the existence of new roads for diverting traffic away from the structures constructed for the Project. Noise assessment should be performed to identify and mitigate any impacts to the affected receptors due to the change in traffic profiles, which may lead to the need of noise barriers alongside the diverted roads.

C. Activities at Stations, Depots and Maintenance Bases, and Repair and Maintenance Works on Tracks

- I. Noise-emitting machinery and equipment used for activities at stations, depots and maintenance bases, and for repair and maintenance works on the tracks, must be checked for proper installation of noise control devices such as mufflers and soundproof enclosures to reduce noise emissions if it were to be operated outdoor, outside the building of the stations, depots and maintenance bases and close to residents and noise sensitive receptors.
- II. Repair and maintenance works along the track, including periodic grinding of rail heads, should be restricted to day-time (7.00 a.m. – 7.00 p.m.) periods and working days only when works are carried out close to sensitive receptors. The intensity of noise activities should be reduced in the evening (7.00 p.m. – 10.00 p.m.) in urban areas so that the generated sound level is below the limits as stipulated in **Table 7-4**.

8.3.2 Vibration

8.3.2.1 Construction Phase

In Chapter 7 an assessment of the potential impacts which the following Project activities could induce on surrounding Receptors in the states of FT. Kuala Lumpur, Selangor and FT. Putarajaya, Negeri Sembilan, Melaka and Johor were discussed, viz:

- I. Vibration from Land Preparation, Earthworks and Demolition Activities
- II. Vibration induced by Vehicle Movements and Transportation of Materials and Equipment
- III. Vibration from Piling Activities

IV. Vibration from Tunnelling

The findings indicated that for certain activities carried out, the resulting impacts exerted on receptors could induce significant adverse perturbations for which mitigation and abatement (M&A) measures were needed to be adopted in order to reduce the intensity of impacts to tolerable levels. The nature and scope of recommended M&A measures are presented herewith.

A. Vibration from Land Preparation, Earthworks and Demolition Activities

- I. Approval of any use of explosives for demolition must be obtained from local authorities, whereby its use should be restricted to working days and during day time (7.00 a.m. – 7.00 p.m.) when working close to nearest recipients/residents. Affected residents should be informed of the expected duration of particular vibration-emitting activities in order to minimise complaints.

B. Vibration from Vehicle Movement and Transportation of Materials and Equipment

- I. Vehicle frequency and movement to and from the construction sites which generate high noise should be reduced when operating outside working hours and during the weekends and public holidays and when passing close to noise sensitive receptors and residential areas.

C. Vibration from Piling

- I. Construction of the elevated tracks, bridges, stations, depots and maintenance bases should employ more silent and low-vibration piling methods such as bored piling, hydraulic press-in or jack-in spun piling when working close to vibration sensitive receptors and residential areas so that the vibration signal is not propagated to the nearest receptor.

D. Vibration from Tunnelling

- I. For construction of tunnel using TBM, free-face drilling approach can be used for excavation involving hard rocks and foundation to reduce underground vibration.
- II. For construction of tunnel using NATM, the impact from blasting can be reduced by restricting blasting to day-time only and adopting controlled blasting approaches such as partial upper/lower blasting and multi-step blasting.
- III. Approval of any use of explosives for demolition must be obtained from local authorities, whereby its use should be restricted to working days and during day

time (7.00 a.m. – 7.00 p.m.) when working close to nearest recipients/residents. Affected residents should be informed of the expected duration of particular vibration-emitting activities in order to minimise complaints.

The measures recommended above must comply with the limits as stipulated in **Table 7-14** in Chapter 7.

The mitigation measures recommended in **Section 8.3.2.1(A-D)** above are in line with BS 5228-2:2009 (Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration) such as restriction on working hours, installation of equipment silencer, equipment closure, selection of piling method, trenches construction and proper equipment maintenance. Hence, it is recommended that the construction activities follow the code of practice as stipulated by BS 5228-2:2009, which covers the need for protection against noise and vibration of persons living and working in the vicinity of construction and open sites. The standard recommends procedures for noise and vibration control in respect of construction operations and aims to assist architects, contractors and site operatives, designers, developers, engineers, local authority environmental health officers and planners.

8.3.2.2 Operational Phase

In Chapter 7 an assessment of the potential impacts which the following Project activities could induce on surrounding Receptors were discussed, viz:

FT. Kuala Lumpur

- I. Vibration from movement of trains at high speed and approaching/leaving stations
- II. Vibration due to Activities at Station Repair and Maintenance Work on Tracks

Selangor / FT. Putrajaya

- I. Vibration from movement of trains at high speed and approaching/leaving stations
- II. Vibration due to Activities at Stations, Depots and Maintenance Bases and Repair and Maintenance Work on Tracks

Negeri Sembilan

- I. Vibration from movement of trains at high speed and approaching/leaving stations

Melaka

- I. Vibration from movement of trains at high speed and approaching/leaving stations
- II. Vibration due to Activities at Stations, Depots and Maintenance Bases and Repair and Maintenance Work on Tracks

Johor

- I. Vibration from movement of trains at high speed and approaching/leaving stations
- II. Vibration due to Activities at Stations, Depots and Maintenance Bases and Repair and Maintenance Work on Tracks

The findings indicated that for certain activities carried out, the resulting impacts exerted on receptors could induce significant adverse perturbations for which mitigation and abatement (M&A) measures were needed to be instituted in order to reduce the intensity of impacts to tolerable levels. The nature and scope of the required M&A measures are presented herewith.

- A. Movement of Trains at High Speed and When Approaching/Leaving Stations
 - I. Vibration isolation device should be installed at track sleepers, ballasts or viaducts in order to properly isolate vibration signals from being passed and propagated to nearest residential areas and vibration sensitive receptors.
- B. Activities at Stations, Depots and Maintenance Bases, and Repair and Maintenance Works on Tracks
 - I. Repair and maintenance works along the track, including periodic grinding of rail heads, should be restricted to night-time (12.00 a.m. – 6.00 a.m.) periods and working days only when works are carried out close to sensitive receptors. The intensity of noise activities should be reduced in the evening (7.00 p.m. – 10.00 p.m.) in urban areas.

The measures recommended above must comply with the limits as stipulated in **Table 7-14** in Chapter 7.

Attenuation of vibration can be further mitigated using the slab track design measures as listed in **Table 8-2**. **Figures 8-1** and **8-2** illustrate examples of typical rail fastening systems that are incorporated in the design of rail tracks.

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Table 8-2: Slab Track Design Measures for Vibration Reduction

| Design Measure | Reduction in Vibration (dBV) |
|---|------------------------------|
| Standard rail strip between rail foot and supporting slab | 3 - 6 |
| High resilience pads | 8 |
| Under base plate between base plate supporting slab | 10 -12 |
| Under-sleeper pads between sleeper and track slab | 10 – 15 |
| Floating slab track (for underground tunnels running under buildings) | N/A |
| Resilient Rail Fasteners | N/A |



Source: www.pandrol.com

Figure 8-1: Typical Rail Fastening System (Pandrol Vanguard Type)



Source: www.delkorail.com

Figure 8-2: Typical Rail Fastening System (Egg Type)

8.4 WASTE MANAGEMENT

8.4.1 Introduction

In Chapter 7, it was concluded that the vast amounts of waste biomass, and of soil materials which have to be disposed as well as imported, have to be effectively managed as otherwise these activities are capable of interacting negatively with the environment. In addition there could be significant amount of demolition waste generated that will require appropriate disposal mechanisms to be planned. The potential scope and intensity of adverse impacts were elucidated, as well as the need for mitigation and amelioration (M&A) measures to be identified to quell potential long term adverse impacts. The potential M&A measures required for the effective disposal of each type of construction wastes is discussed herewith.

8.4.1.1 Construction Phase

8.4.1.1.1 Biomass Management

The potential measures which can be adopted to reduce the severity of impacts associated with the management of huge quantities of biomass (predominantly felled oil palm and rubber trees) include the following alternative approaches viz: (a) combusting the biomass in a controlled manner by either employing a fixed placed (static) incinerator, or a mobile incinerator or by utilising the vegetative residues for firing palm oil mill boilers; (b) mulching and composting the biomass; (c) reutilizing parts of the felled trees (eg. making furniture out of felled trunks); (d) reutilizing the mulched oil palm trees as fertilizer in oil palm estates; (e) disposal of residue biomass to municipal solid waste sanitary landfill facilities or to project dedicated controlled waste repositories and (f) reutilizing the mulched wastes as material that can be applied on bare soils to prevent soil erosion and as a fertilizer to promotes vegetation growth in the cleared areas.



Figure 8-3: Clearing of Palm Oil Tree Biomass Value



Figure 8-4: On Site Mulching

The incinerator option is a feasible option, however not viable as it will be too expensive to adopt over a short period of time (i.e. one-off solution). Mulching and thereafter composting the biomass will be a more preferred option to adopt, however such a practice will require large land areas to be acquired, or leased on a temporary basis, to carry out the composting process, and furthermore a much lower residual mass (25 % of original mass) will still need to be disposed to either landfills or be recycled as a soil conditioner material (with revenue generation potentials).

The trunks of both rubber and oil palm trees are capable of being reutilized to manufacture furniture; especially in the case of rubber trees which is commercially proven. It appears that an entrepreneur has had success in converting oil palm tree trunks into furniture and selling his products overseas. The possibility to dispose of cut and mulched oil palm and rubber tree components in trenches located within the Project's boundary should be explored for its

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practicality and viability. Employing mulched wastes as an anti-erosion measure along cleared areas of the alignment and at Station and Depot sites should be seriously considered.

There appears to be “green” alternatives available to adequately manage the ultimate disposal of biomass residues arising from Project development. It will be the appointed Contractor’s responsibility to dispose of the biomass generated. However because of the vast quantities of biomass that has to be managed, the Project Proponent should guide the Contractor in carrying his/her responsibilities. In this respect the Project Proponent should specify that the Contractor is obligated to, as a first priority, to adopt disposal strategies that place emphasis on recycling and/or reuse options. This would encompass exploring the potential to, as a first priority, to dispose the biomass to markets that are capable of converting the waste to wood products of value (eg rubber and oil palm based furniture, plywood and pulp and paper). Secondly to compost the waste and market it as a fertilizer/soil conditioner; and thirdly to reutilise it as a fuel to fire palm oil mill boilers to raise steam for electricity production. The last option would be to establish dedicated repositories.

Remaining portions of the biomass will be stockpiled temporarily at specified areas for decomposition. The locations of the temporary stockpile locations will be identified before the construction phase of the HSR Project commences in which these stockpile locations will be away from water bodies and sensitive areas along the vicinity of the alignment while preventive steps will be taken to prevent the waste vegetation stockpiles to effect the river network. The stockpiles shall be bunded to prevent any spread of the vegetation stockpiles to areas within the vicinity. Open burning of these stockpiles will be prohibited.

The clearing of forest vegetation within the HSR Project alignment boundary will only be conducted after consultation with the Forestry Departments of Selangor (Bukit Unggul Forest) and Johor (Sg. Pulai Forest Reserve). Surveys will be conducted by personnel from the Forestry Department in collaboration with the HSR Project Proponent to identify any trees of conservation and commercial value that will be removed during site clearing.

The Project Proponent should require the Contractor to submit Waste Management Plan detailing the Approach and Methodology proposed to be adopted to manage the biomass wastes for review by the Project Proponent. This document should also detail out the transportation strategies to deliver the waste material to destination points. The Contractor

shall only commence disposal activities after receiving conditional approvals from the Project Proponent and Local Authority. The Project Proponent's supervising engineers / environmental consultants shall monitor and regulate the biomass disposal operations.

8.4.1.1.2 Soil Materials

Site preparation and earthworks operations will need to be carried out in a controlled manner in order to avoid inducing potential nuisance impacts. Surrounding developments, especially commercial, institutional and residential abodes, as well as tree crop plantation and wetland areas, need to be adequately protected against dust dispersions, noise and vibrations, and potentially flash floods caused by the silting of drains by earthworks operations.

To reduce waste from earthworks and excavated material, suitable excavated material can be reused as fill material for the embankments at necessary areas along the HSR Project alignment boundary as far as possible. The spoil material that comprises of rocky soil from the excavation of tunnelling activities can be utilised for the construction of roads, while granitic rock material obtained can be used as railway ballasts. Spoil material that is found to be unsuitable can be reutilised for landscaping fill or for restoring disturbed sites within the alignment. All excavated material will be handled in a manner that minimises the release of fugitive dust especially during hot and dry weather. The following measures will be adopted within the temporary stockpiling area to reduce potential impacts.

- Identifying locations for temporary stockpile areas that minimize environmental, visual and public health impacts
- Covering of material during heavy rainfall
- Implementing dust suppression measures such as dampening with fine water spray and covering of material with tarpaulin
- Segregation of surface water system for the stockpile of excavated material and fitting of silt traps within regions of the temporary stockpile areas
- Controlling of excessive use of water during spraying to ensure that generation of runoffs are prevented.
- Design of appropriate haulage roads for transport of materials.

Excavated material which cannot be re-used on the site will require disposal at landfill or at approved disposal areas. In the case of excavated material that is contaminated,

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segregation and storage of the material in designated areas which are bunded will be conducted to prevent discharge of contaminated material through water runoffs from rainfall. The contaminated excavated materials will be collected and disposed of by a licensed waste collector as soon as practical.

The Project Proponent shall include the following mitigation and abatement (M&A) measures in the site preparation contract packages to protect the local environment, viz:

- The Project Proponent and/or Contractor shall need to identify external areas where excess unsuitable soils and/or construction wastes can be discarded, and obtain approval from the Local Authority to employ such areas as depositories for the waste materials, prior to initiating site preparation operations. Disposal areas that will be identified in collaboration with the relevant Authorities should be capable of accommodating non-schedule wastes without inducing, inter-alia, elimination of indigenous terrestrial flora and fauna habitats; cause siltation of rivers and streams leading to flooding, and imposing adverse impacts on downstream users of the waterway; pose a danger to survival of aquatic flora and fauna; and create suitable habitats where disease propagating vectors can proliferate. The use of discarded rock from tunnel construction for reclamation purposes, or for purpose of reutilization, needs adequate study and planning.
- The transportation of excess unsuitable soils and/or construction wastes to approved disposal sites, outside of the Project work sites, shall be closely regulated in order not to impact adversely with normal traffic circulation patterns on selected routes. Timing of travel on public roads shall be spaced out in order not to exacerbate peak period heavy traffic flows. Appropriate measures must be taken to ensure that the transported material is well stacked and covered. This will prevent accidental spillages, minimize potential fugitive dust dispersions, and avoid endangering motorists.
- The Project Proponent should request from the earthworks contractor a mandatory Method Statement describing, inter-alia, the identity of the Burrow Area(s); and disposal sites for spoils and discarded construction materials; the types of vehicles that will be employed to cart the fill and wastes materials; certificates of inspection and road worthiness of vehicles employed; routes to be traversed to transport fill to

the Project Sites; to export waste materials; the protective methods to be adopted to prevent spillages of fill material and to prevent fugitive dust dispersions from dump trucks; and precautions to be taken to avoid dust dispersions. Adverse traffic circulation impacts can be mitigated through advance planning of the routes to be traversed to transport fill material from burrow areas to the Project Sites; and to dispose unsuitable soils and construction materials from the Project Sites. Proper scheduling of truck trips is also required to avoid potential adverse impacts.

- The Project Proponent shall instill the need for the Contractor to submit plans for expedient guniting of exposed rock surfaces, and inculcating landscaping works, in order to reduce any soil erosion tendencies especially along barren slopes, etc

8.4.1.1.3 Construction and Demolition Wastes

A large portion of construction and demolition waste will be generated along the HSR Project alignment boundary. Thus to ensure that the amount of construction and demolition waste sent for disposal is minimised, waste reuse, and recycling measures can be adopted as much as possible.

The careful deconstruction or selective demolition of buildings along the alignment represents an approach for clearing the buildings within the HSR Project alignment boundary. Deconstruction can be applied on a number of levels to salvage usable materials and significantly cut waste and reduce disposal. This can range from reusing an entire structure or foundation, to select assemblies and systems, to the careful removal of specific materials or items such as bricks, tiles, metals and timber can be reused or recycled. Additionally, reusing and recycling construction and demolition material can contribute to reducing transportation costs for waste disposal. Once the process of deconstruction of construction and demolition waste is conducted and the reusable and recyclable waste is identified, the material can be for various purposes as shown below:

- The salvaged construction or demolition debris will be placed in storage buildings for reuse on further needs or requirements of the HSR Project.
- The salvaged material will be sold as a resource for other HSR Projects.

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For the construction and demolition wastes that are not able to be salvaged, specific measures must be taken for careful disposal. The following measures below should be adopted for appropriate management of disposal of construction and demolition wastes.



Figure 8-5: Construction Waste Bin

- All construction waste will be collected in designated waste bins before sending out for disposal
- Designated personnel will be assigned to collect waste regularly from all the waste bins, and will be tied up in proper garbage bags before being dumped into large communal construction and demolition bins located within the site.
- The recyclable waste will be separated at source and the remaining waste sent to approved landfills or dumping sites for disposal.

The disposable wastes shall be collected by licensed waste collectors and disposed at approved landfills or dumping sites in each local authority's jurisdiction. **Figure 8-6** illustrates the locations of the landfills in relation to the HSR alignment while **Table 8-3** tabulates the names of the landfills by State. The type and details of each landfill is detailed further in **Appendix 8A**. Approvals will be obtained from the respective landfill operators before the wastes are sent for disposal.

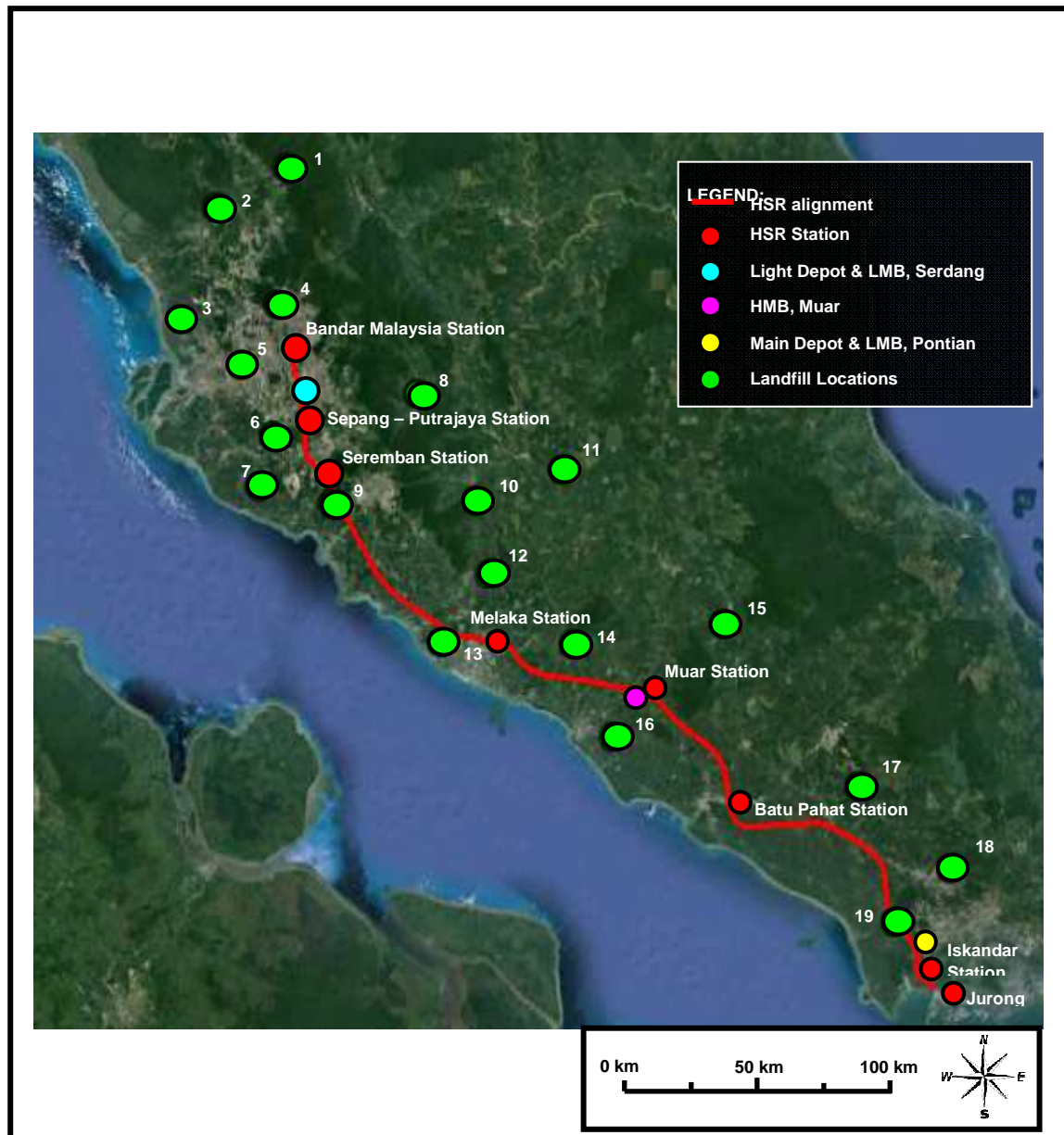


Figure 8-6: Existing Landfill Locations along the HSR Alignment

Source: *Fasiliti Pengurusan Sisa Pepejal, 2017, National Solid Waste Management Department*

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Table 8-3: Names of Landfill along the HSR Alignment

| Indicator | Landfill Name | Approximate Distance from HSR Alignment (km) |
|---|------------------------|--|
| FT. Kuala Lumpur, Selangor and FT. Putrajaya | | |
| 1 | TP Kalumpang | 54 |
| 2 | TPS Bukit Tagar | 50 |
| 3 | TPS Jeram | 37 |
| 4 | SP Taman Beringin | 14 |
| 5 | SP Shah Alam | 17 |
| 6 | TP Dengkil | 10 |
| 7 | TPS Tanjung Dua Belas | 18 |
| Negeri Sembilan | | |
| 8 | TP Sg. Muntoh | 38 |
| 9 | TPS Ladang Tanah Merah | 2 |
| 10 | TP Jalan Kok Foh | 55 |
| 11 | TP Ulu Maasop | 46 |
| 12 | TP Kg Keru | 25 |
| Melaka | | |
| 13 | TPS Sg Udang | 4 |
| Johor | | |
| 14 | TP Bekoh | 11 |
| 15 | TP Jln Muar (Maokil) | 32 |
| 16 | TP Bukit Bakri | 15 |
| 17 | TP Ldg CEP 1 | 18 |
| 18 | TPS Seelong | 22 |
| 19 | TP Pekan Nenas | 0.5 |

Note: TP: Tapak Pelupusan; TPS: Tapak Pelupusan Sampah

Source: Fasilitas Pengurusan Sisa Pepejal, 2017, National Solid Waste Management Department

8.4.1.1.4 Domestic Wastes

Domestic waste that is generated during the construction phase consists of the general refuse that is generated at the Centralized Labour Quarters (CLQ). This typically comprises of general food and beverage waste and dry wastes such as cardboards, and recyclable plastics, and metals. The following measures below can be applied to mitigate the waste impacts.

- Waste receptacles with lids will be stationed at appropriate locations within the CLQ in which wastes will be collected by licensed recyclable collectors at a regular basis
- The waste receptacles will be differentiated based on colour to ensure food wastes and other general refuse is segregated to avoid odour, nuisance and pest problems and the spread of diseases.
- Wastes requiring disposal will be managed and disposed at approved landfills.

The Project Proponent will implement the 5S methodology throughout the construction phase as an effective and efficient waste management strategy at all the HSR stations, depots and maintenance bases. The Project Proponent will also make the continuous implementation of this methodology a mandatory requirement for the Operators during the operational phase. The Project Proponent will provide waste segregation facilities at all the HSR stations, depots and maintenance bases to conform to the 5S principle.

8.4.1.2.5 Scheduled Wastes

Scheduled wastes will be generated during construction phase of the HSR Project from the construction vehicles maintenance activity and spillage from the diesel drums/tank. Scheduled wastes shall be managed according to the requirements of the Environmental Quality (Schedule Wastes) Regulations 2005. Scheduled wastes shall be stored in proper containers and kept in a designated scheduled waste storage area, which shall be roofed to prevent entry of rainwater and must be ventilated adequately. Warning signs shall be clearly visible at the scheduled waste storage area. All scheduled and toxic wastes shall be labelled according to their contents as required by the Third Schedule of the Environmental Quality (Schedule Wastes) Regulations 2005.



Figure 8-7: Scheduled Waste Storage Area

8.4.1.2 Operational Phase

8.4.1.2.1 Domestic Wastes

The domestic waste management that is generated during the operation phase mainly consists of general refuse generated at the stations and by the passengers in the train. These wastes can comprise of aluminium cans, bottles, papers and various forms of plastics, besides the food waste generated at restaurants and cafes at the stations. The following measures will be implemented as the following below.

- Ample recycling bins to be sufficiently provided within the rolling stock and the stations to encourage recycling. Wastes shall then be collected by licensed recyclable collectors at a regular basis.
- General refuse shall be collected on a daily basis by assigned personnel in proper garbage bags and delivered to the appropriate refuse point to be removed regularly by licensed waste collectors.
- Food refuse shall be segregated from other general refuse and ensuring food waste is removed every day to avoid odour, nuisance and pest problems and spread of diseases.
- Wastes requiring disposal will be managed and disposed at approved landfills.



Figure 8-8: Recycling Bins

8.4.1.2.2 Scheduled Wastes

During the operational phase of the HSR Project, scheduled waste such as oil, fuel and grease residues will also be produced from the depot and maintenance base. These wastes will be managed in accordance to relevant regulations such as the Environmental Quality (Scheduled Waste) Regulations 2005. The following mitigation measures will be adopted as below:

- The maintenance of the rolling stock and vehicles shall be conducted in a specified area. The area will be leak proof, which should be made out of concrete.
- Contaminated soils and sediments shall be excavated and stored in appropriate and proper drums for disposal.
- Scheduled waste will be stored in proper drums and is kept in a designated well ventilated storage area with appropriate labels and signs indicating danger or hazards with regards to the waste storage area. The waste storage area should consist of a locked fully bunded area which is impermeable to both water and the waste being stored. The area should also be roofed to prevent rainfall accumulating within the bunded area and have a volume of either 110 % of the largest container or 20 % by volume of the waste stored in the area.
- The drums containing the scheduled waste must comprise of storage drums that are leak proof, durable, and compatible with the scheduled waste stored.
- The scheduled waste will be clearly labelled accordingly based on the type of waste and in accordance to the Third Schedule of The Environmental Quality (Scheduled Wastes) Regulations, 2005.

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- Appropriate spill absorption material should be stored near the storage area in the case of minor spill events.
- The scheduled waste shall be stored for not more than 180 days and will not be more than 20 tonnes unless approval is obtained by the Director General of DOE.
- The transport of scheduled waste will be carried out by a contractor that is licensed. The contractors shall keep a constantly updated inventory of scheduled waste which is stored or sent out in accordance to the Fifth Schedule of The Environmental Quality (Scheduled Wastes) Regulations, 2005.
- The scheduled waste shall only be disposed at prescribed premises.
- Education of workers on the concepts of site cleanliness and appropriate waste management procedures.



Figure 8-9: Labelling of Scheduled Wastes

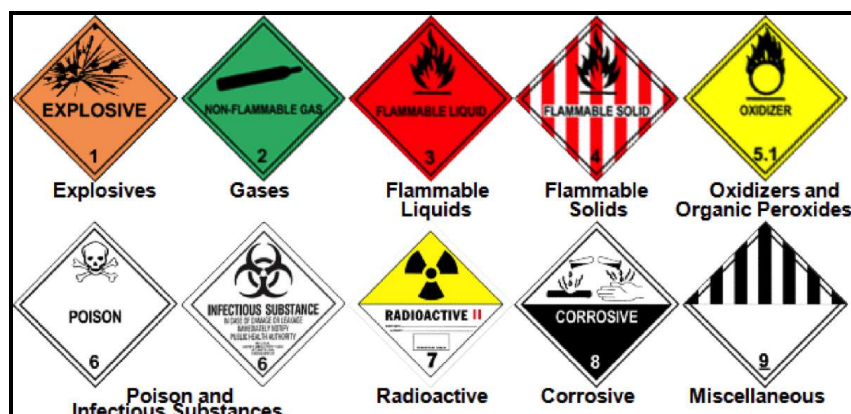


Figure 8-10: Scheduled Waste Labels

8.5 SURFACE WATER QUALITY

8.5.1 Construction Phase

8.5.1.1 Soil Erosion and Sedimentation

The potential for land clearing and earthworks operations to significantly increase the risks and rate of soil erosion and subsequent sedimentation in watercourses has been clearly demonstrated in Chapter 7. Although short term in nature, there should be effective mitigation and abatement measures adopted to reduce the rates of soil erosion and sedimentation in order to prevent intensive soil particulate loadings on receiving watercourses.

Pollution prevention and mitigation measures can be adopted to reduce the intensity of potential soil erosion episodes. These measures include:

- (a) Earthworks to prepare the base of buildings and other structures shall be carried out during the dry season and selectively during the monsoon;
- (b) Any disturbed soil surface shall be immediately levelled trough to prevent creation of slopes which accelerates water runoff;
- (c) Sloping areas at the periphery of the project sites shall be completely terraced with the introduction of berm drains
- (d) For every 10 meters of slope length, slope shall be prepared at less than 45 degree angle;
- (e) Immediate mulching of the exposed ground shall be implemented;
- (f) Geotextile or turf reinforcement mats shall be utilised on slope areas and monsoon drains;
- (g) Sediment basins and silt traps shall be constructed to collect and prevent coarse sediments from being discharged into the river system;
- (h) All waste soils, fill materials and construction materials (e.g. sand, aggregates, etc.) stored on site must be properly protected from the rain;
- (i) All soil stockpile must be located at least 20m away from the nearest water body and have temporary perimeter drains around it that discharges into a sediment basin;

- (j) All filled areas must be properly compacted (following BS1377) to prevent soil settlement, structural failure or unnecessary maintenance costs; and

Site-specific LD-P2M2 plans are prepared for selected segments and facilities of the project site based on available information at this stage as shown in **Appendix 7H2**. The temporary and permanent general pollution prevention and mitigation measures (P2M2) that are recommended for adoption at target sites that is, ie the HSR alignment, stations, depots and maintenance bases, and at river crossing are described in the following sub-sections. Complete and site-specific Soil Erosion and Sedimentation Assessments relevant to each state are attached as **Appendix 7I**.

8.5.1.1.1 Stations, Depots and Maintenance Bases

1. Land clearing shall be carried out in the shortest possible time. Biomass generated from land clearing shall be disposed off-site at an approved landfill. Trunks from the trees can be chipped and used as Mulch to cover up the exposed land.
2. Demolition waste from demolishing of existing structures shall be placed in a temporary stockpile, located at least 20 m away from any drain.
3. Before earthwork commences, Pollution Prevention and Mitigation Measures (P2M2) such as Stabilized Construction Entrance, Wash Trough, Temporary Earth Drain, Check Dam, Silt Fence, Earth Bund and Sediment Basin shall be established onsite.
4. Earthwork shall be carried out from cutting of higher elevation and then fill at the lower elevation. Cut and fill volumes shall be balanced within the project site, where possible. Consideration on allowing for wildlife to escape to the neighbouring forested area is also
5. The cut material from the higher elevations shall be filled at the lower elevations onsite to achieve the desired platform levels. Cut material shall not be disposed outside the project boundary. Excess material can be used as fill material at other approved sites.
6. Silt Fence and Earth Bund shall be constructed at the perimeter of the project boundary to prevent runoff from flowing out uncontrollably.
7. Diversion drain shall be constructed to channel runoff from undisturbed area adjacent to the southern boundary of the project site away from the disturbed area. Where necessary, additional P2M2 such as temporary detention ponds shall be constructed to ensure the Q_{peak} is balanced to avoid flooding downstream.

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8. All runoff within the disturbed area shall be channelled to Sediment Basin by Temporary Earth Drain before discharging out of the project site.
9. All filled areas must be properly compacted (following BS1377) to prevent soil settlement, structural failure or unnecessary maintenance costs.
10. Dust emitted during earthworks need to be reduced by regularly spraying of water to wet the dusty surfaces.
11. Temporary Stockpile shall be located at least 20 m away from any waterway.
12. Close Turfing shall be carried out within 7 days after earthwork is completed on non-built up areas.
13. Sediment basins shall be desilted regularly.
14. Only Total Suspended Solid (TSS) concentration not exceeding 50 mg/l can be discharged to the receiving watercourse. Alternative treatment method such as chemical dosing can be carried out to facilitate sediment control where necessary.
15. Weekly inspection of all P2M2 shall be carried out. In addition, inspection shall be carried out after every raining episode to check the conditions of all P2M2. Immediate remedial action shall be carried out to repair any damaged P2M2.
16. Once construction is completed, all temporary P2M2 such as Temporary Earth Drain, Check Dam, Silt Fence, Earth Bund and Sediment Basin shall be removed from the project site. The disturbed area shall be stabilized with vegetation cover or pavement.

8.5.1.1.2 Construction and Storage Yard

1. The boundary of Construction & Storage Yard shall be clearly marked by Hoarding. The Construction and Storage Yard should be concrete paved to reduce erosion risk.
2. Tyre Washing Facility with a hose and water tank shall be allocated at the entrance to the local paved road.
3. Site clearing shall be carried out within the limit of construction by removal of bushes, undergrowth, small trees, shrubs, debris, etc. The vegetation outside the construction area shall be maintained undisturbed.
4. Site clearance biomass will be temporarily stockpiled at flat area before being transported out from the project site.
5. Temporary Earth Drain shall be installed along the inner section of the Hoarding.
6. Sediment basin shall be installed to receive runoff from the disturbed area.

7. Weekly inspection of all P2M2 shall be carried out. In addition, inspection shall be carried out after every raining episode to check the conditions of all P2M2s. Immediate remedial action shall be carried out to repair any damaged P2M2.
8. All the P2M2 shall be uninstalled and the ground stabilized after construction work is completed.

8.5.1.1.3 Alignment Crossings over Rivers

(a) Viaduct Construction

1. Sandbag Barrier shall be installed along the river bank to prevent runoff from the disturbed area from flowing directly into the river.
2. Excavation for pier foundation of the viaduct shall be carried out with the minimum area disturbed. Sheet pile protection shall be used in the excavation of the pier foundation.
3. Any silt-laden water from the excavation pit shall not be discharged freely into the receiving river.
4. Water accumulated in the excavation pit shall be mechanically pumped into the Roll-off Bin, which is then transported to the nearest Sediment Basin for treatment.
5. In case of heavy clay material with high dispersion content is present, Active Treatment System (ATS) by use of chemical dosing can be used to reduce the TSS in the runoff before discharging out of the construction site. The choice of chemical dosing shall be suitable to the soil type of the project site, subject to further soil test.
6. Excess soil material from the excavation shall be placed in a Temporary Stockpile and then sent to the approved site for filling. The Stockpile shall be installed perimeter control such as a low bund or Sandbag Barrier. Tarpaulin sheet shall be used to cover the Stockpile. Alternatively, excess soil material from the excavation shall be placed in a Roll-off Bin and then sent to the approved site for filling.
7. Balanced cantilever bridge method shall be adopted as the preferred method used to construct the elevated platform over the rivers. All construction activities, materials and waste shall be suitably control to avoid disturbing the river banks.
8. The river bank shall not be disturbed throughout the construction period.
9. Weekly inspection of all P2M2 shall be carried out. In addition, inspection shall be carried out after every raining episode to check the conditions of all P2M2. Immediate remedial action shall be carried out to repair any damaged P2M2.

10. All the P2M2 at each pier shall be uninstalled and the ground stabilized with Close Turfing after construction work is completed at each segment of the viaduct.

(b) Bridge Construction

1. A layer of Silt Fence and Sandbag Barrier shall be lined along the upper slope bank where river crossing for the alignment is located.
2. Excavation for pier foundation of the bridge shall be carried out with the minimum area disturbed. Sheet pile protection shall be used in the excavation of the pier foundation.
3. Any silt-laden water from the excavation pit shall not be discharged freely into the receiving river.
4. Water accumulated in the excavation pit shall be mechanically pumped into the Silt Trap.
5. Excess soil material from the excavation shall be placed in a Temporary Stockpile and then sent to the approved site for filling. The Stockpile shall be installed perimeter control such as a low bund or Sandbag Barrier. Tarpaulin sheet shall be used to cover the Stockpile.
6. Balanced cantilever bridge method shall be adopted as the preferred method used to construct the elevated platform over the river. All construction activities, materials and waste shall be suitably control to avoid disturbing the river banks.
7. Weekly inspection of all P2M2 shall be carried out. In addition, inspection shall be carried out after every raining episode to check the conditions of all P2M2. Immediate remedial action shall be carried out to repair any damaged P2M2.
8. All the P2M2 at each pier shall be uninstalled and the ground stabilized with close turf after construction work is completed. Any exposed or disturbed area shall be stabilized and covered with Hydroseeding or Close Turfing.

8.5.1.1.4 Road Crossing

1. The boundary of the At-Grade construction site shall be clearly marked by Hoarding, according to the progress of work.
2. Tyre Washing Facility with a hose and water tank shall be allocated at the entrance to the local paved road.

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3. Site clearing shall be carried out within the limit of construction by removal of bushes, undergrowth, small trees, shrubs, debris, etc. The vegetation outside the construction area shall be maintained undisturbed.
4. Site clearance biomass will be temporarily stockpiled at flat area before being transported out from the project site.
5. Diversion drain shall be constructed at the upper slope (where applicable) to intercept the surface run-off and channel away from the construction site to the lower terrain for discharge.
6. Pipe/Box Culvert shall be installed at stream or drain crossings to allow natural flow of runoff from the higher ground to the lower ground. Discharge outlet of the pipe culvert shall be lined with a layer of gravel as energy dissipater.
7. Temporary Earth Drain shall be constructed at the lower slope of the construction site. The earth drain shall be channeled to a silt trap for treatment before discharge. Discharge outlet of the silt trap shall be lined with a layer of gravel as energy dissipater.
8. Fill embankment shall be constructed to create the platform for railway track. Fill slopes shall be covered with grass by hydroseeding.
9. Once the railway track is completed at a specified stretch, Hydroseeding or Close Turfing shall be carried out within 14 days to reduce the duration and area of the disturbed land being exposed to rain. A layer of Silt Fence and Sandbag Barrier shall be lined along the upper slope bank where road crossing for the alignment is located.
10. Excavation for pier foundation of the viaduct foundation shall be carried out with the minimum area disturbed. Sheet pile protection shall be used in the excavation of the pier foundation.
11. Any silt-laden water from the excavation pit shall not be discharged freely into the receiving water body.
12. Water accumulated in the excavation pit shall be mechanically pumped into the Silt Trap.
13. Excess soil material from the excavation shall be placed in a Temporary Stockpile and then sent to the approved site for filling. The Stockpile shall be installed perimeter control such as a low bund or Sandbag Barrier. Tarpaulin sheet shall be used to cover the Stockpile.
14. Viaduct shall be constructed on elevated platform over the road. All construction activities, materials and waste shall be suitably controlled.

15. Weekly inspection of all P2M2 shall be carried out. In addition, inspection shall be carried out after every raining episode to check the conditions of all P2M2. Immediate remedial action shall be carried out to repair any damaged P2M2.
16. All the P2M2 at each pier shall be uninstalled and the ground stabilized with close turf after construction work is completed.

8.5.1.1.5 Tunnel Portals

1. Construction of the tunnel portal shall commence with cutting of the slopes, from the higher elevation to the lower elevation (**Figure 8-11**).

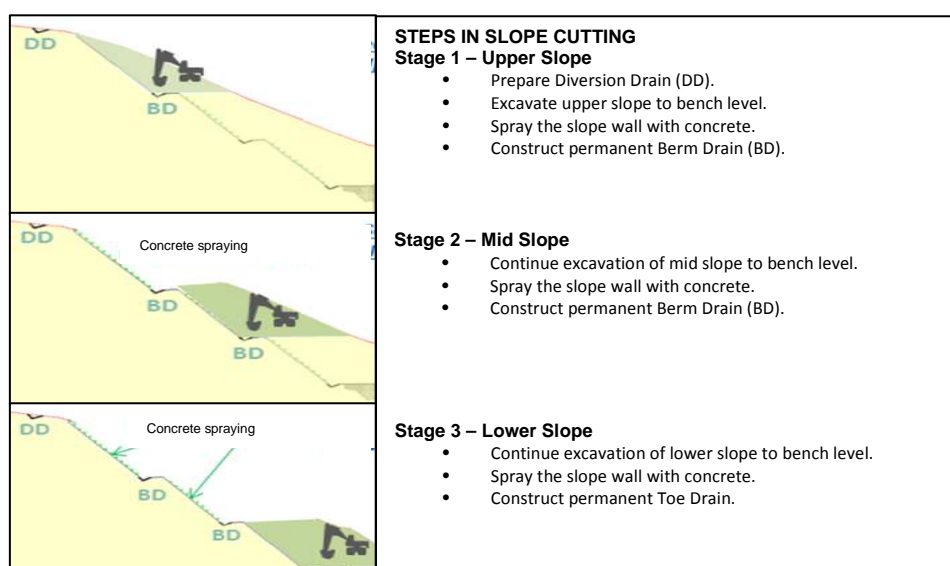


Figure 8-11: Steps in Slope Cutting of the Tunnel Portal

2. Excess material from the excavation of tunnels shall be transported to other sections of the project site where filling is needed. Other excess material shall be sent to approved disposal sites by local authorities identified by the appointed Contractor.
3. Any unsuitable materials such as slurry soil shall be transported to the Slurry Facilities at the Working Yard to drain out the water. Where necessary, Active Treatment System shall be used to remove suspended solids from the slurry to reduce the TSS concentration to less than 50 mg/l.
4. Once construction works are completed, the Construction Yard shall be removed and the disturbed site shall be stabilized with Hydroseeding or Close Turfing within 14 days to reduce the duration and area of the disturbed land being exposed to rain.

8.5.1.1.6 Slope Cutting

1. Cutting of slope is necessary to stabilize and create berms along the alignment crossing over undulating or hilly terrain. It is imperative that the sequence of slope cutting be carried out in such way to minimize erosion risk. Slope cutting shall be carried out not more than 500m length at any one time.
2. Before physical work commences, diversion drain shall be established at the upper boundary of the proposed cut slope. The diversion drain shall receive runoff from undisturbed area and channels it downstream to the receiving river via pipe culvert. Runoff from the diversion drain shall not be mixed with runoff from the Temporary Earth Drain.
3. Discharge outlet of the pipe culvert shall be stabilised with crusher run to reduce the flow velocity of the runoff and spread out the flow, therefore reducing scouring of the ground surface.
4. Slope cutting will be carried out by excavator from the uppermost elevation to the lower ground. The cut slope gradient shall be 1 (V) : 1.5 (H) with minimum 1.5 m berm width at every 5.0 m height. For rocky slope, the cut slope gradient shall be 4 (V) : 1H.
5. Berm drain shall be constructed to receive runoff from each slope surface and channels to the cascading drain at the side. The cascading drain shall flow into the Temporary Earth Drain with check dams to reduce flow rate. The runoff is channelled across the proposed road via a pipe culvert. The runoff is then discharged to the nearest sediment basin. Runoff from the Temporary Earth Drain shall not be mixed with runoff from the diversion drain. The drainage system shall be regularly inspected and maintained, especially after each heavy downpour. To protect the earth drain from scouring by runoff, drain surface can be protected with a layer of erosion blanket with average mass of 360 to 400 g/m².
6. Erosion risk is very high on slope exceeding 25° steepness. The cut slope shall be covered with erosion blanket as soon as the slope is established (do not wait for 14 days after slope cutting). The erosion blanket or any equivalent method shall be secured to the cut slope by soil nailing. The erosion blanket shall have an average mass of 360 to 400 g/m². Hydroseeding shall be carried out once the erosion blanket is installed on the cut slopes.

7. Permanent slope stabilization measures on soil slope such as soil nailing, soil anchor, spray concrete and gunnitting, rubble pitching shall be carried out within 14 days after slope cutting is completed.
8. Slope stabilization measures on rock slope such as rock face dentition, rock bolt/anchor or rock dowel, gunnitting surface protection and spray concrete shall be carried out within 14 days after slope cutting is completed.

8.5.1.1.7 Fill Embankment

1. Slope of 1V:2H shall generally be adopted for fill embankment with minimum 1.5 m berm at every 5.0 m height.
2. Perimeter Earth Drain shall be constructed at the outer rim of the filled area. Discharge outlet of the perimeter drain shall be protected with Check Dam or loose rocks as Energy Dissipater.
3. When filling, every 200 mm lift of soil layer shall be compacted up to 95%.
4. Once filling is completed at each stretch, Hydroseeding or Turfing shall be carried out immediately. Perimeter filled slope with 25° and above shall be protected with Erosion Blanket followed by hydroseeding.

8.5.1.1.8 Removal of Unsuitable Material

Generation of unsuitable material from excavation of pier foundation on location with limited working space will increase the risk of erosion and sedimentation to the nearby river or drain. In addition, rainwater runoff mixed with the excavated soil may form slurry and muck.

Roll-off bins can be used to temporarily store the excavated material and transported to an approved Excess Material Disposal Site for filling. Slurry mixture of soil material and runoff may be sent to the nearest Sediment Basin to allow sufficient time for settling. **Figure 8-12** shows examples of water-tight Roll-off Bins.



Figure 8-12: Example of Roll-off Bins

Based on the Soil Investigation results and the interpretive reports, unsuitable material for engineering works are likely to be from the soft alluvial clays found near the river deposits and swampy area. Suitable disposal sites will need to be identified. The criteria of suitable disposal sites are:

- The site shall be low lying but not within a flood zone;
- The site shall be located away from surface watercourses;
- The site shall not be groundwater recharge areas;
- Proper drain and collection sump shall be constructed at the perimeter of the disposal site to retain sediment runoff.

8.5.1.1.9 Active Treatment System (ATS)

Active treatment system (ATS) refers to the treatment of runoff using a mechanical system with the application of coagulants and flocculants to promote the settling of suspended solids out of the aqueous phase. Only coagulants and flocculants which have been approved for use by environmental agencies such as USEPA or similar authorities are allowed to be used.

ATS can be used in the following conditions:

- (a) In the event when the TSS discharge exceeds the EIA approved standard
- (b) When analysis of soil investigation in the project site shows the dispersible fine-grained clays contain more than 10 % of dispersible material
- (c) There is limited space to provide adequate size of Sediment Basin.

Example of an ATS set up and process is given in **Appendix 7H2**.

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8.5.1.1.10 Site Specific P2M2

The type of P2M2 to be adopted for the construction of the project at each state is tabulated in the following sections. All LD-P2M2 plan drawings are attached in **Appendix 7H2**.

(a) FT. Kuala Lumpur, Selangor and FT. Putrajaya

Table 8-4: P2M2 Measures and Drawings for FT. Kuala Lumpur, Selangor and FT. Putrajaya

| Type | Name / Location | LD-P2M2 Plan Drawing |
|---------------------------------------|--|---------------------------|
| Station | Bandar Malaysia | HSR/MIN/UKMP/KUL/BMS001 |
| | Sepang – Putrajaya | HSR/MIN/UKMP/PU/S001 |
| Depot | Light Depot and Light Maintenance Base | HSR/MIN/UKMP/SEL/DPT/D001 |
| Alignment Crossing over Rivers | Sg. Semenyih | HSR/MIN/UKMP/SEL/A001 |
| | Sg. Langat | HSR/MIN/UKMP/SEL/A002 |
| | Sg. Kerayong | HSR/MIN/UKMP/KUL/A001 |
| Tunnel | Bukit Unggul Golf & Country Club and Jalan Kajang-Dengkil. | HSR/MIN/UKMP/SEL/A004 |

(b) Negeri Sembilan

Table 8-5: P2M2 Measures and Drawings for Negeri Sembilan

| Type | Name / Location | LD-P2M2 Plan Drawing |
|--|------------------|-----------------------|
| Station | Seremban | HSR/MIN/UKMP/NGS/S001 |
| Alignment Crossing over Rivers | Sg. Linggi | HSR/MIN/UKMP/NGS/A001 |
| Alignment Crossing Over Roads | Pengkalan Kempas | HSR/MIN/UKMP/NGS/A002 |
| | | HSR/MIN/UKMP/NGS/A003 |
| Tunnel | Sendayan | HSR/MIN/UKMP/NGS/A004 |
| Slope Cutting and Fill Embankment | Sendayan | HSR/MIN/UKMP/NGS/A005 |

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(c) Melaka

Table 8-6: P2M2 Measures and Drawings for Melaka

| Type | Name / Location | LD-P2M2 Plan Drawing |
|--|-------------------------|-----------------------|
| Station | Melaka | HSR/MIN/UKMP/MLK/S001 |
| Alignment Crossing over Rivers | Sg. Durian Tunggal | HSR/MIN/UKMP/MLK/A003 |
| | Sg. Melaka | HSR/MIN/UKMP/MLK/A004 |
| | Sg. Linggi | HSR/MIN/UKMP/MLK/A005 |
| Slope Cutting and Fill Embankment | Kg. Solok Hilir, Bemban | HSR/MIN/UKMP/MLK/A001 |
| | Sg. Durian Tunggal | HSR/MIN/UKMP/MLK/A002 |

(d) Johor

Table 8-7: P2M2 Measures and Drawings for Johor

| Type | Name / Location | LD-P2M2 Plan Drawing |
|---------------------------------------|---------------------------------------|---------------------------|
| Station | Iskandar Puteri | HSR/MIN/UKMP/JHR/IP/S001 |
| | Batu Pahat | HSR/MIN/UKMP/JHR/S002 |
| | Muar | HSR/MIN/UKMP/JHR/S003 |
| Depot | Main Depot and Light Maintenance Base | HSR/MIN/UKMP/JHR/DPT/D001 |
| | Heavy Maintenance Base | HSR/MIN/UKMP/JHR/H001 |
| Alignment Crossing over Rivers | Sg. Pulai | HSR/MIN/UKMP/JHR/A003 |
| | Sg. Ayer Hitam Besar | HSR/MIN/UKMP/JHR/A007 |

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| Type | Name / Location | LD-P2M2 Plan Drawing |
|--|------------------------------------|-----------------------|
| Slope Cutting and Fill Embankment | Kg. Ladang & Kg. Pok Besar (south) | HSR/MIN/UKMP/JHR/A001 |
| | Kg. Ladang & Kg. Pok Besar (north) | HSR/MIN/UKMP/JHR/A002 |
| | Pekan Nenas (south) | HSR/MIN/UKMP/JHR/A004 |
| | Pekan Nenas (north) | HSR/MIN/UKMP/JHR/A005 |
| | Kg. Sawah Dalam, Pontian | HSR/MIN/UKMP/JHR/A006 |
| | Kg. Bukit Seri Wangi (south) | HSR/MIN/UKMP/JHR/A008 |
| | Kg. Bukit Seri Wangi (north) | HSR/MIN/UKMP/JHR/A009 |

8.5.1.2 Sewage / Wastewater Management

- Adequate toilet facilities to be set up within the construction work site as well as construction CLQ sites; and sewage discharges to be routed to temporary treatment facilities conforming to Ministry of Health and Sewerage Services Department guidelines. If Septic Tanks with filters are employed for sewage treatment then they should be desludged once every two years; and to engage licensed contractors to dispose of the recovered sludge without causing environmental damage. Scheduled maintenance and inspection of machinery and plant, and provision of masonry bunds around fuel tank skids should be ensured. The sewage treatment system should be regularly inspected and maintained to ensure efficient removal of BOD and COD to prevent deterioration of the quality of the receiving water body.

8.5.2 Operational Phase

8.5.2.1 Soil Erosion and Sedimentation

All cut slopes should be periodically monitored for evidence of erosion or destabilisation; especially during wet seasons. Remedial measures should be enforced diligently to prevent land slips/slides.

Slopes should be vegetated adequately at all times with suitably selected vegetation species.

8.5.2.2 Sewage / Wastewater Management

As described in Chapter 7, the HSR stations are located in developed areas. Hence, sewage flows from the stations shall be discharged to adjacent public sewerage schemes for treatment.

In cases where it is not possible to discharge raw sewage flows to an adjacent public sewerage scheme, then efforts should be made to segregate the raw flows into grey (flows not containing faecal matter or urine) and black (mainly composed of faecal matter, urine and kitchen wastes) wastewaters; and to recycle the grey wastewaters for use within the Station/Depot. In either case the pollutant loads discharged to the recipient waterway is not expected to induce negative water quality shifts that would affect aquatic life or prohibit other economical use of the receiving waters.

8.6 MARINE WATER QUALITY

8.6.1 Alignment Crossing Over Tebrau Strait

8.6.1.1 Introduction

The potential impacts which activities associated with the construction and operations of that sector of the HSR alignment which crosses over Tebrau Strait and terminates at the MY-SG border have been elucidated under Chapter 7. For the most part it was concluded that minimal transient potentially adverse impacts on the water quality, hydrodynamic properties and harboured marine ecosystem status could materialize especially if appropriate mitigation measures are not instituted during the construction and operations periods, especially the former. The following narrative summarises the required mitigation measures that should be adopted by the Project Proponent and its contractors and operators to ensure insignificant residual adverse impacts are induced by Project related activities.

8.6.2 Construction Phase

No additional mitigation measures are required during piling activities as no significant suspended sediment plume is predicted. It is noted that this assessment is based on the use of cofferdams to construct the piers in the mudflat areas, and adoption of conventional piling methods in deeper foreshore waters.

Other mitigation measures focusing on other potential water quality pollutants are recommended as described below:

- Waste management plan, which include procedures for collecting, storing, processing and disposing of garbage generated on vessels should be adopted to reduce generation of wastes and the potential water pollution.
- Wastes / wastewater generated by working vessels should be stored on board (in appropriate storage container) and be taken back to base for eventual transfer to shore facilities and their eventual disposal.
- All marine vessels should operate under the requirements of Regulation 11 of MARPOL 73/78 where the discharge of sewage into the sea is prohibited.
- Marine vessels shall carry oil and spill response kit in case fuel is spilt.

8.6.3 Operational Phase

During the operational phase, the operator of this system to include waste identification and requirements for disposal as part of the Standard Operating Procedure (SOP) for routine maintenance as well as EOP to address accidental spills.

8.7 GEOLOGY AND HYDROGEOLOGY

8.7.1 Geology and Geotechnical

8.7.1.1 Construction Phase

The following mitigating measures as shown in **Table 8-8** are proposed to ameliorate adverse geological impacts on construction of HSR Structures.

Table 8-8: Geology Mitigation Measures

| State | Geology Mitigating Measures |
|------------------|---|
| FT. Kuala Lumpur | <p>The piers of an elevated structure will be built mainly in limestone and granite. The piers of the elevated structure must be piled on hard material (SPT>50) or on the bedrock to increase the stability of the elevated structure. Use deep foundation compared to shallow foundation.</p> <p>Bored piles shall be preferred over driven piles in limestone areas due to:</p> <ul style="list-style-type: none"> • Should there be cavities with roofs of inadequate thickness, there will be risk of collapse of the roofs if piles bear on the roofs. Bored piles can penetrate through the cavity roofs and socket a sufficient depth into the bedrock. • Driving of piles is not allowed in many populated parts of FT. Kuala Lumpur due to noise pollution. • Due to erratic limestone rock surface, piles tend to deviate during driving <p>Site investigation shall be conducted with great detail in Limestone area to detect karstic features and fault zones. Tunneling through the karstic limestone is a challenging task when the tunnel encounters the weak zones. Soil Investigation (SI) shall be carried out at closer intervals to obtain more realistic information about the sub-soil profile and soil parameters.</p> |

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| State | Geology Mitigating Measures |
|----------|---|
| | <p>The methods of excavation shall be by TBM. TBM excavation is most suitable to prevent the settlements in the buildings and other infrastructures, like train lines, bridges and water and gas collectors. Tunnel linings shall be required structurally, to retain the earth and water pressure and operationally to provide an internal surface appropriate to the function of the tunnel. Tunnel linings shall be designed in accordance with the relevant regulatory standards, guidelines and current practice. These are based on proven design and construction technology that has been used successfully worldwide. The linings shall be designed to withstand loading, including loads from the surrounding ground and groundwater. They will also meet fire prevention and durability. The majority of the bored tunnels excavated by TBM shall be lined with pre-cast concrete tunnel lining segments, reinforced with steel bar or/and steel fibres and polypropylene fibres. A high standard of waterproofing of the tunnel linings shall be provided. Ground leakage rates shall not exceed 5ml/m²/h. For any 10m length of tunnel the water ingress rate shall not exceed 10ml/m²/h.</p> <p>Support systems shall be used to prevent roof collapse. Rock fall and groundwater seepage into the tunnel shall be controlled by using good engineering measures. Misjudgment in the design of support systems can lead to very costly failures. Spot bolts and shotcrete shall be used to stabilize the roof of the tunnel in highly jointed rock mass. Rock quality probing ahead of tunnel excavation, grouting, lattice girders and steel arches shall also be used. These measures shall limit the excessive groundwater flow associated with weak zones. The HSR alignment shall cross the active or inactive faults at great intersecting angles to minimize the overlapping between them. The rail track or tunnel shall cross the fault line at right angle.</p> |
| Selangor | <p>The piers of elevated structure can be safely sited on the bedrock of meta-sedimentary rock. This geology formation is a competent ground with adequate bearing capacity for heavy loads such from the piers and trains. Competent subsoil such as medium dense</p> |

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| State | Geology Mitigating Measures |
|-----------------|--|
| | <p>sand or stiff cohesive soils, with adequate bearing capacity to support the embankment. It is envisaged that no special foundation treatment is required for such conditions, except replacement / re-compaction of the sub-grade. Deep foundation shall be adopted for elevated piers to transfer the structural loads to a deeper founding stratum and to minimize any excessive total or differential settlement. The foundation for At-Grade foundation shall be made by using embankment on the ground</p> <p>Care should be taken that loads shall not be transferred to foliated directions. Tunnelling in metamorphic rock shall be influenced by the foliation planes especially when the excavation is in the same direction as the dip of the stratum. Tunnelling in phyllite shall be supported using lining or any other supports. In the second tunnel, the interbedded of quartzite and slate (shale) behave differently to the excavation technique being employed in the construction of the tunnel.</p> |
| FT. Putrajaya | <p>All slopes made must be designed and cut taking into account the orientation of these weakest planes. Special care and treatment dealing with graphite in soil shall be conducted such as soil removal and/or the usage of lime to neutralise an acidic soil. Concrete made with supersulphated cement has a reputation for better acid resistance than portland cements shall be used during construction.</p> |
| Negeri Sembilan | <p>Tunnelling in metamorphic rock shall be influenced by the foliation planes especially when the excavation is in the same direction as the dip of the stratum. Tunnelling in phyllite shall be supported using lining.</p> |
| Melaka | <p>All slopes made must be designed and cut taking into account the orientation of these weakest planes. Special care and treatment dealing with graphite in soil shall be conducted such as soil removal and/or the usage of lime to neutralise an acidic soil. Concrete made with supersulphated cement has a reputation for better acid resistance than portland cements shall also be used during construction.</p> |

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| State | Geology Mitigating Measures |
|-------|---|
| Johor | <p>For embankment in poor sub-soil conditions, various methods of ground improvement shall be considered. The method of ground improvement adopted depends on the following factors; (i) Height of embankment; (ii) Existing ground conditions, including thickness, type and properties of soil strata; (iii) Time available for construction; (iv) cost consideration and (v) Site constraints.</p> <p>Detailed investigation of the subsoil shall be conducted such as using boreholes or trial pits. Thorough study shall be carried out to evaluate the properties of these soft materials such as their load bearing capacity, strength, compressibility, liquefaction, differential settlement and expansiveness of the marine clay. Expansive soils are typically associated with fine grained marine clay soils that have the potential to shrink or swell with the repeated changes in the moisture content.</p> <p>Embankments shall be designed and constructed so that maximum settlement occurring after completion and handover of sub-ballast layer shall not exceed 100 mm over 25 years at a rate less than 10 mm per year. The differential settlement shall not exceed 4 mm per year over a length of 30 m and 10 mm per year over a length of 200 m.</p> <p>Peat soil and marine are highly compressible with low bearing capacity. In peat area, removal of peat up to 2 m depth and Replacement (R/R) with suitable fill material shall be considered. For thicker peat layer and high fill embankment more than 12 m, generally piled embankment has been considered. Stone Column (SC) or Piled Embankment (PE) with continuous pile-caps are specified at locations where deeper depth of treatment is required. Stone column are considered for fill height not exceeding 10 m. The length of Stone Column varies from 10 m to 24 m and spacing from 1.5 m to 2.5 m. The length of pile varies from 9 m to 27 m and spacing from 1.2 m to 2.5 m.</p> <p>Mitigation measures to control peat fire are by having facilities to</p> |

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| State | Geology Mitigating Measures |
|-------|---|
| | wet the peat area by constructing check dam or groundwater production well for controlling the fire. The natural hydrology system of the peat area shall not be seriously interrupted. The use of fire and open burning at peat area shall be prohibited especially during the construction stage of this rail track. |

Other mitigation measures during the construction phase will encompass:

- (i) Soil Investigations (SI) should be carried out at closer intervals and to obtain more realistic information about the sub-soil profile and soil parameters. This investigation shall cover all areas, in particular, bridges, elevated structures, tunnels, stations, cut areas, fill area, culverts and retaining wall. Boreholes (BH) shall be proposed for bridges, elevated structures, and cut slopes. For fill embankment both borehole and Cone Penetration Test (CPT) are proposed. This data shall be used for the design of ground improvement in fill area, stabilization works for cut area, foundation of all structures.
- (ii) Mitigation for slopes
 - (a) Slope stability analysis

Slope stability analysis, including establishing design criteria and performing calculations, shall be required for all cut, fill and natural slopes. Slope stability analysis shall include; i. Stability analysis for the temporary stability measured during construction. ii. Cut and fill slope stability analysis should include both circular and non-circular analysis and in multi-mode of failure. iii. Any slope that is influenced by surcharge load shall be analysed taking into consideration of this surcharge load.
 - (b) Rock slopes

All Rock slopes shall be analysed and designed. Preliminary consideration can be used using 4V:1H for weathering grade I and 3V:1H for weathering grade II. If analysis indicates that it is unstable, it shall be designed to a better gradient and/or requiring extensive stabilisation measures. The type of stabilisation

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measures to be used can be one of the following: permanent rock anchors, rock dowels, rock bolting, and buttress walls, counter forts, relieved drains.

(c) Cut slopes

All untreated slopes shall be designed with minimum of 2m berm width and maximum 6m berm height with a Factor of Safety greater than 1.3. Stabilisation measures can be considered when the design is inadequate. Stabilisation measures may include the following: - soil nailing with slope surface protection; permanent ground anchors; retaining walls, etc. The maximum number of berms for cut slopes shall be restricted to 6 berms. If the design shows that more than 6 berms are required, other solutions such as tunnel, rock shade, bridges etc. shall be considered.

(d) Fill slopes and embankments

All untreated fill slopes and embankments shall be designed with 2 m berm width and 6m berm height with a minimum Factor of Safety of 1.3. Stabilizations measures can be considered when the design is inadequate. And may include the following:-geogrid/geotextiles reinforcement; reinforced concrete retaining structure; reinforced fill structure; replacing the fills with elevated structures. Due to maintenance reasons and to minimize risk to the users, the maximum number of berms for fill slopes shall be restricted to six (6) berms. If the design shows that more than 6 berms are required, other solutions such as bridges, viaduct etc. shall be considered.

(iii) Ground treatment

The summary of ground treatment methods that can be used for highly compressible materials such as peat and marine clay is presented in **Table 8-9**.

Table 8-9: Summary of Ground Treatment that shall be used for Highly Compressible Materials

| Types of ground treatment | | Description |
|---------------------------|------------------------|--|
| R/R | Remove and Replacement | This method is proposed where the incompetent /unsuitable soil layer thickness is less and is underlain by a soil layer competent enough to sustain the embankment load. |

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| Types of ground treatment | | Description |
|---------------------------|------------------------------|--|
| | | Considering the time, cost and possible requirement of temporary works at certain locations, the depth of removal is limited to about 3 m. In this method, the recommended thickness of unsuitable material is removed and replaced with granular / suitable material and compacted in layers. Refer to Replacement Method in Figure 5-39 of Chapter 5. |
| DR | Dynamic Replacement | This method is proposed where the thickness of incompetent / unsuitable, soft compressible material is not more than 6 m. In this method, after the site clearance, a layer of granular drainage blanket (about 1 m thick) is placed over the ground. A heavy mass is dropped a few times from a suitable height to compact the ground and form a crater. This crater is filled with granular drainage blanket and the filled material is again compacted. This is repeated over the area in a grid form at a suitable spacing, generally about 5 m. The ground is levelled and is again compacted with a few passes of vibratory roller (Ironing Phase) to obtain a uniform surface before embankment construction. Refer to Dynamic Compaction in Figure 5-39 of Chapter 5. |
| PVD | Prefabricated Vertical Drain | This method is proposed where the thickness of incompetent / soft compressible soil more than 6 m. Considering the stability of embankment during construction, staged construction with waiting period between stages, this method is not practicable generally for fill height greater than 6 m including surcharge. After the site clearance, a layer of granular drainage blanket (about 750 mm thick) is placed and PVD is installed. A second layer of drainage blanket is provided after PVD installation. Where required, Counter Weight Berm (CWB) is also provided to improve the stability of embankment. The spacing of drains is designed considering the available construction time. Refer to Vertical |

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| Types of ground treatment | | Description |
|---------------------------|------------------|---|
| | | Drain Method in Figure 5-39 of Chapter 5. |
| SC | Stone Column | This method is proposed where the thickness of incompetent / soft compressible soil more than 6 m. Due to increased strength of soft compressible soil, improved stability and load carried by the stone column, this method can be adopted generally for fill height up to about 10 m including surcharge. After the site clearance, a layer of granular drainage blanket (about 1000 mm thick) is placed and stone column is installed. The waiting period between stages and the construction time is less compared to that required for PVD. The stability of fill can be improved by providing geotextile reinforcement. The spacing is designed considering the height of fill and stability during construction. |
| PE | Piled Embankment | This method is proposed for fill height more than 12 m and where the stability of fill during construction cannot be assured using other methods of ground treatment. The construction time for embankment fill supported on pile foundation is less compared with other methods of ground treatment. The pile spacing is designed based on the fill height and the piles are connected by a pile raft. Refer to Pile Slab Method in Figure 5-39 of Chapter 5. |

8.7.1.2 Operational Phase

Mitigation measures during the operational phase will encompass:

- (i) Regular monitoring of groundwater levels

If there is a significant increase in groundwater levels, measures should be taken to pump out excess water from the area to prevent water from rising above ground level.

(ii) Fire prevention in peat areas

Peat areas that have dried up due inability of water to flow from one area to another through the compacted ground along the railway tracks have the potential of catching fire due to the slow burning of organic material in the soil. Measures should be in place to water dry peat areas to prevent or put out fires.

8.7.2 Hydrogeology

8.7.2.1 Construction Phase

Monitoring of groundwater condition (levels and quality) at the nearest existing wells to the HSR alignment on the downstream of groundwater flow at a higher frequency. The exercise is to be conducted during the construction phase as well as during high speed train operation.

In addition, piezometers are to be installed at depots and stations that are constructed on the groundwater related environmentally sensitive areas such as alluvium deposits and peat lands in south of Negeri Sembilan and west and southwest of Johor in particular. Groundwater monitoring exercise is to be conducted to provide baseline information on groundwater condition prior and during the HSR construction, as well as to verify the impact of the project operation to groundwater in the surrounding area, if any.

Leaking or accidental spillages of contaminant such fuel and lubricants etc. that may occur directly into watercourses or infiltrate into groundwater need to be avoided. At the same time, appropriate design of drainage infrastructure is unconditionally required to prevent infiltration of contaminant into the local groundwater system.

8.7.2.2 Operational Phase

The local ecosystem and profile of high water bearing formation such as alluvium and peats need to be prevented. Disruption to the area is to be minimised by particularly developing elevated railway. No major impervious barrier that crossing and preventing the natural groundwater is be constructed in the area.

8.8 HYDROLOGY

8.8.1 Construction Phase

Summary of potential impacts during construction phase for all segments (FT. Kuala Lumpur, Selangor and FT. Putrajaya, Negeri Sembilan, Melaka and Johor) for HSR Project activity:

1. Sediment transport into the river
2. Surface erosion and sedimentation
3. Flash flood & localized flooding

Mitigation measures for sediment transport into the drainage/ river

- i. The site clearing impact from this activity can be minimised by scheduling the cutting and removal of biomass.
- ii. If possible, the construction of U-wall, trenches, retaining walls or slope treatment (Temporary/ permanent) should be done first and far away from the water courses (at least 20 m from the drainage or riverbanks).

Mitigation measures for surface erosion and sedimentation

- i. Proposed station must be adjacent to existing landmark and plantation land (contamination – potential impact for the existing environment).
- ii. Melaka Station is adjacent to water treatment plant (Temporary Earth Drains and sediment basins must be designed for contamination control).
- iii. Muar Station is located at adjacent to Muar River (contamination control have been required) to this stations construction.
- iv. Proper terrains must be constructed beside the steep roads to avoid landslide or slope failure. Wherever river crossing to be made, a proper bridge must be constructed bank to bank to avoid minimal disturbance to water body.
- v. Adequate LD-P2M2 measures should be implemented where earthworks and construction of hauling roads are carried out to mitigate impacts of erosion.
- vi. Close proximity of local unnamed watercourse must be use where the environmental considerations and erosion, sediment control must be required.

Mitigation measures for flash flood & localized flooding

- I. The lack of rainfall, flow and water level data in most proposed alignment is a serious shortcoming that should be addressed. It is further recommended that funds should be made available in the budget of the current project to design a strategy to implement the collection of critical data. This data should then be used to monitor future flood events and compare actual measurements with the model results. The construction programme and a flood management plan must be designed for the construction phase when the town will be most susceptible to flooding.
- II. Mitigating measures on the impacts from site preparation can be minimized by re-using the previously cleared areas for the camp sites. These can minimize removal of terrestrial vegetation.
- III. For drilling activities, the construction of perimeter trench or bund can avoid loose soils to be washed away by runoff.
- IV. Proper dedicated channels must be constructed and installed along the diversion tunnel/ river. The size must be adequate to cater for river discharge during normal and flood flows. Minimum number of piers for the elevated structures of the HSR alignment within flood prone areas are proposed in order to minimize flood flow and flood debris impact (especially during worst case scenario).

Water Yield Management

Baseflow is groundwater flow that enters the stream or river by way of deep subsurface flow below the main water table, and is affected by the net effect of changes in evapotranspiration and rainfall infiltration opportunities following forest removal. If the infiltration rates, after the catchment disturbance have reduced to the extent that increases in surface storm runoff during rainfall exceed the gain in baseflow associated with lower evapotranspiration loss, then diminished dry season flow will occur and the river will eventually dry up. Conversely, if soil infiltration capacity is maintained, increase in dry season flow can be expected, as the soil water storage is already higher than before forest removal.

Therefore, appropriate mitigating measures would include:

- i. Using standard reduced impact logging techniques as applicable to land clearing, i.e. those techniques aimed at reducing soil damage. Such techniques include, but are not limited to: Winching rather than direct dragging, skidding on top of debris, pre-

planned skid tracks, use of light machinery, limitation to work during drier periods, commence planting soon.

- ii. Development or land clearing should be spread over different sub catchments instead of concentrated in one big catchment. This is to help in reducing total water loss and sediment yield.

8.8.2 Operational Phase

There are several mitigation measures to associate the construction of the HSR Project that are expected to reduce the hydrological impacts during operation phase. The activities which have been identified are as follows:

1. Light Depot and Light Maintenance Base (LMB),
2. Heavy Maintenance Base (HMB), and
3. Main Depot and Light Maintenance Base (LMB).

The mitigation measures on the environment for the above-mentioned activities are outlined below:

Waste/wastewater Management

During the operational phase of the HSR Project, minimum impacts to the hydrology sector is predicted for all segments along the alignment. However, the significant impact is predicted due to Depot and Maintenance Base activities where if waste/wastewater generation is not properly managed, it will be affected to river ecosystems, river flow, river capacity and flash flood will be happens. Therefore, appropriate mitigating measures would include rubbish collecting system to solve the solid waste pollution problems where this problem can infect water flow on the drainage system and floodgate system. Improper maintenance causing constriction to flow and backflow in drainages or rivers during operations must be avoided. Continuously monitoring and proper maintenance to the river and drainage system is proposed to control the flooding issues in the future.

8.9 TERRESTRIAL ECOLOGY

8.9.1 Construction Stage

Limit Site Clearing and Earthworks within Dedicated Areas

Site clearing, tunnelling and earthworks activities should be restricted to designated footprint areas as much as practicable in order to reduce the potential magnitude of any land disturbance impacts. The authorities reserve the right to determine the cutting, uprooting, destroying and felling of trees for any part of the HSR Project area within their respective purview and the Project Proponent (and the respective contractors) shall comply with the stipulated rules and regulations. The forestry department has a standard operating procedure (SOP) for timber cutting in the forest including best management practices (BMPs) which should be complied with by the logging contractor.

Clearing of the site should also be carried out starting from residential areas, outwards in a single direction towards and into the plantation and forest areas. This will provide time and passage to enable the animals to move further into the plantation or forest in search of a new home, thus reducing human-wildlife conflicts and preventing the animals from seeking shelter in the residential areas instead.

The Department of Wildlife and National Parks (PERHILITAN) recommended that the project proponent and the contractor should ensure that a secure fence is constructed to prevent encroachment of wildlife into the worksite and the railway line during construction. Hunting activities are totally prohibited. The project proponent and the contractor should ensure that the construction workers do not carry out any hunting activities. PERHILITAN also recommended that all the construction workers be given training and awareness pertaining to prohibition of hunting and other prohibited activities as listed in the Wildlife Conservation Act 2010 (Act 716). Public awareness campaigns regarding wildlife conservation should also be expanded to cover the local communities adjacent to the alignment.

The Forestry Department has a standard operating procedure (SOP) for timber cutting in the forest including best management practices (BMPs) which should be complied with by the logging contractor. The Project Proponent will notify PERHILITAN prior to the

commencement of land clearing activities and ensure that land clearing and preparation activities are carried out in a controlled and staged manner.

Proper Management and Disposal of Wastes

Biomass should be disposed off at designated and approved dumpsites. Some of the plant parts can also be utilized as rip-rap in marshy grounds during construction works and used as protective materials/mulching against surface erosion of exposed grounds. Large trees can be chopped off with wood recoverable for sale. Small trees and branches can be used for making chipboard, or cleared together with palm fronds and shrubs by slashing, or shredded and stacked across slopes for erosion control/runoff barrier. No open burning of biomass is allowed.

Proper management of garbage and solid wastes is essential to prevent littering and pollution of nearby water bodies. Garbage bins should be provided to discourage proliferation of roaches, flies and scavenger animals (particularly rodents that could transmit communicable diseases like leptospirosis and scrub typhus). Garbage should be properly disposed off at designated landfills. Worksites, depot and Centralized Labour Quarters (CLQs) should be checked and cleared of any solid wastes at the end of each working day. PERHILITAN also recommended that monkey-proof garbage bins or equivalent measures should be installed for solid waste disposal in areas where monkeys are the main pests creating human-wildlife conflicts.

At the CLQ and depots, disposal of scheduled wastes and effluents should follow proper procedures to prevent ground and water pollution impacting terrestrial and aquatic flora and fauna. The river reserves and river corridors must be left untouched to avoid erosion and slope failure. The distance of the river reserve must comply with the Department of Irrigation and Drainage (JPS) regulations. Proliferation of pests and disease vectors is part of the adverse impacts of improper solid waste disposal which would affect animals and humans alike.

Employment of LD-P2M2 for Soil Erosion and Water Quality

Removal of unwanted biomass and shrubs and the control of slope and soil erosion should follow proper guidelines and the LD-P2M2 procedures as given in the relevant section of this EIA report.

Although further reduction in water quality is expected with a rise in turbidity and sediment loads during earthworks and construction of facilities, utilities and infrastructures, these impacts, are expected to be temporary and localized, and can be resolved with proper mitigating measures of LD-P2M2, such as installing retention ponds and silt curtains in the rivers at worksites to retain sediment loads, immediate compaction of exposed soil, returfing and other standard soil protection works.

Protection and Preservation of Mangroves, Riparian Habitats and River Banks

To preserve natural riparian habitats as much as possible, the marshy grounds adjacent to the riparian zones (e.g. Sg. Langat, Sg. Semenyih, Sg. Linggi and Sg. Muar) can be stabilised with ground treatment in accordance with best practices to accommodate for post-construction/differential settlement of pavements/platforms. Both structural and geotechnical solutions can be applied in areas of soft/unconsolidated grounds to achieve the most economical and safest construction performance. A balanced cantilever method should be the preferred method employed for the construction of elevated structures over the mangroves and rivers.

Sufficient numbers and sizes of culverts can be provided in areas of soft grounds, consistent with providing a satisfactory drainage layout which safeguards the integrity of the HSR alignment and associated facilities, as well as the surrounding environment, for which the project proponent will adhere to the latest requirements of Jabatan Pengairan dan Saliran (JPS) in connection with works on rivers or other water bodies.

Preparation and Implementation of Wildlife Management Plan

Although the HSR alignment does not cut through the Bukit Bindu Forest Reserve in Johor that is home to three individuals of *Lembu Bali* (*Bos javanicus*), the distance of the alignment (approximately 400-700 m) from the fringes of the forest reserve makes it necessary to

mitigate impacts that may affect any protected wildlife and forestry resources from poaching and illegal harvesting. The Project Proponent should conduct a detailed inventory of the *Lembu Bali* in order to prepare and implement a Wildlife Management Plan to protect this and other wildlife species. The methodology and mitigation measures suggested must be discussed with and approved by the Department of Wildlife and National Parks (PERHILITAN).

Protection of Aquatic Life in Rivers

For the continuous survival of fish and other aquatic life during construction works at river crossings, dissolved oxygen (DO) content in the rivers and drainage systems can be improved with increased flow and aeration; thus, it is important that the channels not be clogged or stagnated by construction debris and other obstructions. Reduced DO and increased biochemical oxygen demand (BOD) will jeopardize aquatic life in the rivers; thus, proper design of drainage layouts is important to ensure regular flow and aeration.

Landscaping and Re-vegetation

It is proposed that ornamentals and landscaping trees which are removed should be replanted where necessary and required. The authorities reserve the right to determine the preservation of trees or replanting thereof for any part of the project area within their respective purview and the Project Proponent (and the respective contractors) shall comply with the stipulated rules and regulations. Landscaping should also be provided for open spaces at the stations, depots, associated roadsides and along some of the buffer zones of the HSR alignment and in the green areas in accordance with the stipulated rules and guidelines. Ornamentals and hedgerow shrubs should be planted in open spaces and green areas to enhance the visual aesthetics and ecosystem services of the project area. Suitable choices of plant species for landscaping works will facilitate ground succession as the root zone of trees and shrubs would anchor the soft ground and accelerate consolidation of the soil. Re-turfing and landscaping of disturbed grounds should follow relevant standard procedures and guidelines.

Care should be taken in selecting the types and locations of ornamental trees and shrubs to ensure minimal obstruction and to avoid the root system of ornamentals and wayside trees from disrupting/undermining the pavement structures and underground facilities when they

reach maturity. Suitable choices of landscaping species are important to ensure easy maintenance and to minimise pest problems. Local and endemic species should be preferred over alien and exotic species to reduce infestation risks and disease problems to our cultivated crops and native species.

Proper landscaping and re-vegetation will enhance the aesthetic qualities of the project area. However, chemical fertilisers should be applied judiciously to avoid enrichment of the tidal and sub-tidal areas which can trigger algal bloom. Organic fertilisers are recommended. Local indigenous species should preferably be utilised for re-vegetation and landscaping purposes to preserve local biodiversity.

Landscaping is a positive impact on habitats and communities. The proper choice and maintenance of landscaping trees, flowering plants and ornamentals would encourage beneficial fauna and pollinators such as bees, butterflies and other insects, bats and birds into the area, thus providing food resources for herbivores and carnivores further up the food chain and supporting local biodiversity of species. Furthermore, it is highly recommended that enrichment planting with year-round fruiting and flowering trees and plants (like bananas, papayas, figs, jambu, etc.) should be implemented in the buffer zones to provide additional/new food resources for wildlife, thus reducing their encroachment into the buffer zone or nearby settlements and orchards.

Mitigation of Human-Wildlife Conflict

The project proponent and the contractor should ensure that the construction of the CLQ and the presence of the construction workers do not disturb the wildlife in the nearby areas. The CLQ should be situated away from the wildlife habitats. There should be no CLQ or temporary storage areas located within forests or plantations, as this will attract animals seeking shelter or food to encroach. Domestic wastes (especially food) should be properly managed and noise to be kept to a minimum level within the CLQ, as animals may be attracted to the smell and noise generated at the CLQ. CLQ should also be appropriately fenced to prevent encroachment of animals into the premises.

Hunting activities are totally prohibited. The project proponent and the contractor should ensure that the construction workers do not carry out any hunting activities. PERHILITAN recommended that the all the construction workers should be given training and awareness

pertaining to prohibition on hunting and other prohibitive activities as listed in the Wildlife Conservation Act 2010 (Act 716). Public awareness campaign regarding wildlife conservation should also be expanded to cover the local communities adjacent to the alignment.

8.9.2 Operational Phase

Habitat Fragmentation

The impacts of habitat fragmentation on wildlife and other fauna can be mitigated by enrichment planting of the buffer zone areas with suitable flowering and year-round fruiting trees such as jambu, local figs (waringin or ara), papaya, etc. With bountiful food resources available to the wildlife, they will not encroach upon the cultivated land and settlement areas, thus avoiding human-wildlife conflict. The Wildlife Departments of Johor and Negeri Sembilan had also requested that the Project Proponent, as part of its Corporate Social Responsibility (CSR) and good rapport to supply the affected villages (through their JKKK committees) with some cage traps, to facilitate PERHILITAN in the capturing and transferring of any pest/nuisance wildlife, especially monkeys, to nearby protected forests.

Since the alignment when at grade, mostly passes through settlements, oil palm and rubber plantations and does not cut through any forest reserve that include the home range of protected wildlife such as elephants and tigers, it not anticipated that there is a necessity for animal crossing to be provided along most of the alignment route. However, PERHILITAN has recommended that wildlife crossing should be provided at strategic points of the at-grade alignment to mitigate for habitat fragmentation. This wildlife crossing would serve to connect the fragmented habitats bisected by the alignment. It would avoid wildlife collision with the passing train by providing a safe passage to enable wildlife to move across the alignment freely. The wildlife crossing will be included in the WMP if deemed necessary following advice from PERHILITAN. The advice and approval by PERHILITAN should be solicited for the detailed design of the wildlife crossing.

It is also recommended that the Project Proponent solicit advice and cooperation of relevant agencies, i.e. PERHILITAN in providing effective mitigating measures to resolve the human-wildlife conflict issues. Some measures which have been implemented in this country and elsewhere include construction of barrier trenches and traps and fencing where applicable,

to prevent refugee wildlife such as wild pigs and monkeys from encroaching onto the HSR alignment or the nearby significantly affected farms, orchards and settlements.

PERHILITAN also recommended that monkey-proof garbage bins or equivalent measures should be installed for solid waste disposal at the stations and maintenance depots in areas where monkeys are the main pests creating human-wildlife conflicts.

Preservation of Mangroves

Mangroves support a wide variety of plants and wildlife species, particularly birds (migrants as well as residents). Consequently, it is important to introduce a number of protection and conservation measures to ensure sustainability of the mangrove buffer, as well as to mitigate for potential environmental impacts of the HSR Project. The key measures (strategies) are related to the protection and management of the mangrove stands of Sg. Muar, Sg. Linggi and Sg. Pulai as protection buffer adjacent to the proposed development [refer to Appendix 8B, Kamaruzaman Jusoff (2008). *Managing Sustainable Mangrove Forests in Peninsular Malaysia*].

To ensure the sustainability of healthy mangroves and mudflats as breeding and nursery grounds for coastal and riverine species of fish, prawns, crabs, gastropods and other shellfish, a mangrove replanting programme is recommended to replenish diebacks and degraded stands due to project development within the protected mangrove reserves.

For mangrove replanting and management, a special task force should be set-up that comprises the Project Proponent, the Forestry Department, mangrove expert and JKKK local communities. The conservation and preservation of mangroves should be carried out as a joint collaboration between the local communities, relevant agencies and stakeholders and NGOs.

User-friendly maintenance roads should be provided in the Forest Reserve areas at Sg. Pulai for the Project Proponent to conduct all maintenance works for the HSR alignment and a permit should be obtained to enter the forest area through this dedicated maintenance road to minimize encroachment into the forest habitats.

Wildlife Collision

Collision and mortality of wildlife at elevated sections of the alignment is not an issue, as the animals do not have access to the railways tracks. However, it is possible that the animals will attempt to cross the At-Grade railway tracks to get to the other side in search for food and shelter. Collision of wildlife with the high speed trains can be mitigated by installing suitable barrier fencing or trenches along the At-Grade alignment to prevent encroachment of animals onto the tracks. These fences or trenches must be inspected and maintained properly, to ensure that there are no sections that have been damaged by animals or trespassers.

PERHILITAN recommended that the project proponent and the contractor should provide wildlife crossing in the areas identified as a wildlife passage to avoid encroachment of wildlife into the alignment that could result in collision with the high speed trains, thus risking the wildlife and the passengers. However, the wildlife crossing will be included in the WMP if deemed necessary following advice from PERHILITAN.

Preparation and Implementation of Environmental Management Plan

The HSR Project contractor shall be required to prepare an Environmental Management Plan and conform to the environmental protection guidelines that identify procedures to minimize environmental impacts resulting from the HSR Project's work procedures. The guidelines shall be incorporated into the HSR Project plans and specifications to be used by the HSR Project contractors.

Preparation and Implementation of Wildlife Management Plan (WMP)

The project proponent and the contractor should prepare and implement a Wildlife Management Plan (WMP) for this project. The advice of and approval by PERHILITAN should be solicited for the preparation of the Wildlife Management Plan (WMP). Mitigating measures to reduce human-wildlife conflicts (as discussed earlier) will be elaborated in the Wildlife Management Plan (WMP).

The project proponent and the contractor should notify PERHILITAN before the commencement of any site clearing works. The site clearing works must be conducted in a controlled and systematic manner so as to minimize any adverse impacts on wildlife.

The project proponent and the contractor should undertake all control and mitigating measures to ensure that there would be no significant adverse impacts on wildlife in the worksite as well as in the human settlement area during site clearing, construction and operation phases of the project.

Rehabilitation of Site due to Project Abandonment

The abandoned project site should be rehabilitated and protected to avoid further deterioration of the environment. The abandoned project site should be sealed off from public access with proper fencing and secured walls. Warning signages and notices to inform and create safety awareness among the public should be erected at strategic locations. Any abandoned vehicles, equipment and incomplete structures should be removed or demolished. The site should be restored for other beneficial uses by carrying out proper remediation and landscaping works.

8.10 MARINE ECOLOGY

No mitigation measures specific to plankton are proposed. Mitigation measures related to the control of water pollution as outlined in the Water Quality section will further minimize impacts to plankton.

8.11 LAND TRAFFIC

Based on the traffic count survey and forecasted traffic due to Pre-construction, Construction and Operational phase of the HSR Project along with assessment of potential land traffic impact, indicates that certain activities would result in impacts being imposed to the sensitive receptors in this case the road networks surrounding the Project. In order to limit traffic impacts to the on-going traffic, mitigation measures shall be implemented during the Pre-

construction and Construction as well as the Operational Phase. Both phases have specific requirements that need to be implemented. The description of these mitigation measures is narrated below.

8.11.1 Pre-Construction and Construction Phase

All Stations

During the Pre-Construction and Construction phase, it is envisaged that temporary road signs and traffic control devices shall be placed at strategic location to direct the traffic, all in accordance with the approved Traffic Management Plan (TMP). The TMP should be in accordance with one the following documents as applicable to the Relevant Authority or namely, Dewan Bandaraya Kuala Lumpur, Majlis Perbandaran Sepang, Majlis Perbandaran Kajang or Perbadanan Putrajaya, Majlis Perbandaran Seremban, Majlis Bandaraya Melaka Bersejarah and Majlis Perbandaran Muar, Majlis Perbandaran Batu Pahat dan Majlis Bandaraya Iskandar Puteri.

- i. New Guidelines for Traffic Management during Construction (Road Engineering Association of Malaysia (REAM).
- ii. Malaysia Highway Authority Traffic Management Implementation Guidelines.
- iii. JKR Arahan Teknik (JALAN) 2C/85 Manual on Traffic Control Devices for Temporary Signs and Work Zones Control.
- iv. JKR Arahan Teknik (JALAN) 2D/85 (Pindaan 2017) – Manual on Traffic Control Devices: Road Marking and Delineation.

Where the HSR alignment crosses roads, the structures are positioned in accordance with the following configurations and TMP methodology will suit these configurations:

a. Piers and portal columns at the road median.

- i. Existing road side utilities and drains will be relocated as near as possible to the limit of the road reserve. Both sides of the road will be widened. Lane replacement will be based on a one to one basis depending on the lane taken up to create the working area. The realignment of the lane shift will be redesigned based on the posted speed of the existing roadway. If temporary speed reduction is required to accommodate the TMP, approval from relevant authorities should be obtained.

- ii. While general sequencing of works affecting roadway will need to be submitted by the contractor at start of construction. TMP will be developed and submitted to relevant authorities for approval at least 3 months prior to TMP implementation.
- iii. The lanes adjacent to the median should be cordoned off using New Jersey Profile Barriers and hoardings with access opening provided without affecting sightline.
- iv. Temporary road signs and traffic control devices should be placed to direct the traffic, all in accordance with the approved TMP.
- v. Trained flagmen should be stationed at the road diversions to direct and control the traffic during peak hours.

b. Piers and portal columns by the road side.

- i. No traffic diversion will be required.
- ii. New Jersey Barriers and hoardings should be erected at the road edge with access openings provided.
- iii. Temporary road signs and traffic control devices should be placed to direct the traffic, all in accordance with the approved TMP.
- iv. Trained flagmen should be stationed at the work areas to direct and control the traffic during peak hours.

c. Piers and portal columns at interchanges.

- i. If the piers or columns are positioned within an interchange, it will usually necessitate the temporary closure or shifting of roadway of an existing road and slip road due to working space constraints. In closure situations, an alternative route will be provided using the existing road network. A comprehensive TMP, Traffic Impact Assessment report (TIA) and Road Safety Audit report (RSA) will be carried out on the temporary alternative route.
- ii. Piers and portal columns at interchanges.

d. Site access to HSR alignment.

- i. No traffic diversion will be required.

- ii. Temporary site access to the HSR alignment shall be design to a standard priority junction with adequate sightline. Where high volume of traffic is expected, the junction maybe need to be upgraded to a signalized junction.

e. Temporary road diversions

All temporary road diversions will be removed and temporary lane and road closures will be ended once all works have been completed. All temporary road signs and control devices will be removed, the original road alignment reinstated and road surface resurfaced. The original road will be handed back to the relevant authorities for maintenance.

8.11.2 Operational Phase

During the operational phase, all facilities that have been built is expected to have met local Authorities requirements prior to the revenue service. However, care still need to be undertaken but the project proponent for the safe and sustainable operation of the HSR facilities. Herewith below, description by station of the required measures to be carried out:

FT. Kuala Lumpur

The Bandar Malaysia Station will be accessible through the following modes of transportation:

- Taxi and buses - bus bays and taxi pick-up bays will be provided along with taxi waiting area/ queuing storage bays;
- Private cars - Multi-storey Park and Ride facilities will be provided along with private cars drop-off bays and pick-up bays at Departure and Arrival halls respectively;
- Future MRT Line 2 & 3 - Based on current proposal, the future MRT Line 2 and 3 in Bandar Malaysia will be integrated at concourse of the HSR station via a pedestrian link way;
- Will provide pedestrian sheltered / high-quality walkways whether At-Grade or elevated walkways with crossings at high pedestrian generators such as city centre stations and commercial precincts within or at the station. These walkways will be sheltered where possible.

- Will provide direct pedestrian Overhead Bridge and Subway for direct access from stations into major developments like shopping centres.
- Will provide interchange Connection for connecting stations.

Hence, the Project Proponent should appoint a traffic consultant to carry out TIA to assess and propose mitigation to address the road traffic and pedestrian circulation issues due to the completion of HSR station and Bandar Malaysia Development. Adequate and regular interval of signages should be provided to guide motorists to the station facilities and amenities.

In case of occurrence of train derailment or collision, special Standard Operating Procedure (SOP) steps should be designed to address this situation.

Selangor – FT. Putrajaya

The Sepang-Putrajaya elevated station planning will allow for provision to interchange with future Putrajaya Tram. Sepang-Putrajaya elevated station will be accessible through the following modes of transportation:

- Taxi and buses – bus bays and taxi pick-up bays will be provided along with taxi waiting area/ queuing storage bays;
- Private cars –Multi-storey Park and Ride facilities will be provided along with private cars drop-off bays and pick-up bays at Departure and Arrival halls respectively.
- Will provide pedestrian sheltered / high-quality walkways whether At-Grade or elevated walkways with crossings if required within or at the station. These walkways will be sheltered where possible.

Therefore, adequate signages shall be placed at strategic locations to guide the motorists to the station facilities and amenities.

In case of occurrence of train derailment or collision, special SOP steps should be designed to address these problems.

Negeri Sembilan

Seremban At-Grade station will be accessible through the following modes of transportation:

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- Taxi and buses – bus bays and taxi pick-up bays will be provided along with taxi waiting area/ queuing storage bays;
- Private cars –Multi-storey Park and Ride facilities will be provided along with private cars drop-off bays and pick-up bays at Departure and Arrival halls respectively.
- Will provide pedestrian sheltered / high-quality walkways whether At-Grade or elevated walkways with crossings if required within or at the station. These walkways will be sheltered where possible.

Hence, adequate signages shall be placed at strategic locations to guide the motorists to the station facilities and amenities.

In case of occurrence of train derailment or collision, special SOP steps should be designed to address these problems.

Melaka

Melaka elevated station will be accessible through the following modes of transportation:

- Taxi and buses – bus bays and taxi pick-up bays will be provided along with taxi waiting area/ queuing storage bays;
- Private cars –Multi-storey Park and Ride facilities will be provided along with private cars drop-off bays and pick-up bays at Departure and Arrival halls respectively.
- Will provide pedestrian sheltered / high-quality walkways whether At-Grade or elevated walkways with crossings if required within or at the station. These walkways will be sheltered where possible.

Considering the above, adequate signages should be placed at strategic locations to guide the motorists to the station facilities and amenities.

In case of occurrence of train derailment or collision, special SOP steps should be designed to address these problems.

Johor

Muar Station

Muar elevated station will be accessible through the following modes of transportation:

- Taxi and buses – bus bays and taxi pick-up bays will be provided along with taxi waiting area/ queuing storage bays;
- Private cars – Multi-storey Park and Ride facilities will be provided along with private cars drop-off bays and pick-up bays at Departure and Arrival halls respectively.
- Will provide pedestrian sheltered / high-quality walkways whether At-Grade or elevated walkways with crossings if required within or at the station. These walkways will be sheltered where possible.

The above connectivity means signages are important and shall be provided at strategic locations to guide the motorists to the station facilities and amenities.

In case of occurrence of train derailment or collision, special SOP steps should be designed to address these problems.

Batu Pahat Station

Batu Pahat elevated station will be accessible through the following modes of transportation:

Taxi and buses – bus bays and taxi pick-up bays will be provided along with taxi waiting area/ queuing storage bays;

- Private cars – Multi-storey Park and Ride facilities will be provided along with private cars drop-off bays and pick-up bays at Departure and Arrival halls respectively.
- Will provide pedestrian sheltered / high-quality walkways whether At-Grade or elevated walkways with crossings if required within or at the station. These walkways will be sheltered where possible.

Adequate and at regular interval signages should be provided to guide the motorists to the station facilities and amenities.

In case of occurrence of train derailment or collision, special SOP steps should be designed to address these problems.

Iskandar Puteri Station

Iskandar Puteri At-Grade station will be accessible through the following modes of transportation:

- Taxi and buses – bus bays and taxi pick-up bays will be provided along with taxi waiting area/ queuing storage bays;
- Private cars – Multi-storey Park and Ride facilities will be provided along with private cars drop-off bays and pick-up bays at Departure and Arrival halls respectively.
- Will provide pedestrian sheltered / high-quality walkways whether At-Grade or elevated walkways with crossings if required within or at the station. These walkways will be sheltered where possible.

Adequate and at regular interval signages should be provided to guide the motorists to the station facilities and amenities.

In case of occurrence of train derailment or collision, special SOP steps should be designed to address these problems.

8.12 MARINE NAVIGATION

Mitigation measures, including signage and advanced warnings, have been proposed to reduce the significance of effects associated with the following activities within the navigable channels:

- Reduced air draft clearance.
- Presence of cofferdams or other temporary structures for construction of the piled caps.
- Frequent movements of construction vessels and its support vessels.

Observation of the collision regulations by all construction related vessels should be done and all signals and lights that should be displayed are displayed at all appropriate times. This must be stressed to all vessels masters that are engaged in the activities at the sites.

Contingency plan to cover all emergencies shall be made available and all personnel involved and coming to the construction site must be made aware and understand the contingency plan. If necessary, exercises should be regularly conducted.

Piling is an activity, in this particular case, conducted from piling vessels. The characteristics of these piling vessels would be having at least four (4) mooring anchors or most likely be eight (8) mooring anchors, chains and wires be attached to the mooring winches. These anchors would be placed at a distance from the piling barge by the anchor handling tugs. Each anchor location would be marked by a locator buoy for easy retrieval of the anchor. The locator buoy must be marked in accordance with IALA standards. The character and colour of the lights should comply with the requirement of the Marine Department.

Should the closure of any section of the HSR Bridge between piers be required for the construction of the elevated structures, close coordination with the Marine Department Wilayah Selatan will be required to formulate additional mitigation measures and to issue the Notice to Mariners and Port Notice.

8.13 VISUAL

8.13.1 General Mitigation Measures

From the detail impact assessment, it was found that in overall, 100 areas will have no impact, 76 (moderate adverse impact), 56 (adverse impact) and 25 (major adverse impact). For the major adverse impacts, the 25 areas were zoned into 11 zones, in which 3 zone in Selangor, Negeri Sembilan (2), Melaka (2) and Johor (3). Due consideration of the fact that the design of the HSR stations has incorporated local cultural values has also been taken into account. It is noted that majority of the impacts are irreversible because HSR structure will permanently constructed on ground and will continue influencing existing environmental visual quality. Therefore there is necessity to mitigate the impacts to ensure HSR developments are compatible with surrounding visual environment and the mitigation measures must be taken into account during before construction (design phase) during construction and after construction period.

a) Visual Mitigation Strategy During Design Phase (Before Construction)

To mitigate the impacts identified along the HSR development alignment during design phases or before construction period, three (3) mitigation approaches have been selected which are based on the concept of reduce, restore and replace.

- i. Reduce refer to the visual mitigation measures that can minimize the visual impacts of developments and the measures includes:

1. *Control the placement of the vertical structure* – the HSR vertical structures (viaducts and stations) must not be seen dominating the skyline of the areas especially in the hilly or slope zone.



Figure 8-13: Structure Complementing the Surrounding Landscape

2. *Conforming architecture style with the surrounding landscape character* – the architecture style of the buildings (especially station) must follow the surrounding or local architecture style as close as possible. If the buildings need to be in contrast to the surrounding areas, the design must be unique and have sound architecture style.
3. *Control the painting of the structures to conform to surrounding color* – the color of the structure (especially the viaducts, depot and maintenance buildings) must conform to surrounding areas common color. For example, green for natural areas and grey for urban areas.

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The color of the structures must not dominate the surrounding environment visual environment.

4. *Hide unnecessary infrastructure cables where feasible* – infrastructures cables should be hide from public viewing. The cable can be buried on ground or concealed within buildings/structure system.
5. *Treatment for noise pollution must consider visual quality* – the devices to control noise on selected areas must be designed to suit with surrounding environment landscape. The devices should allow people to view surrounding landscape and not be in contrast in term of size, color, texture and form.

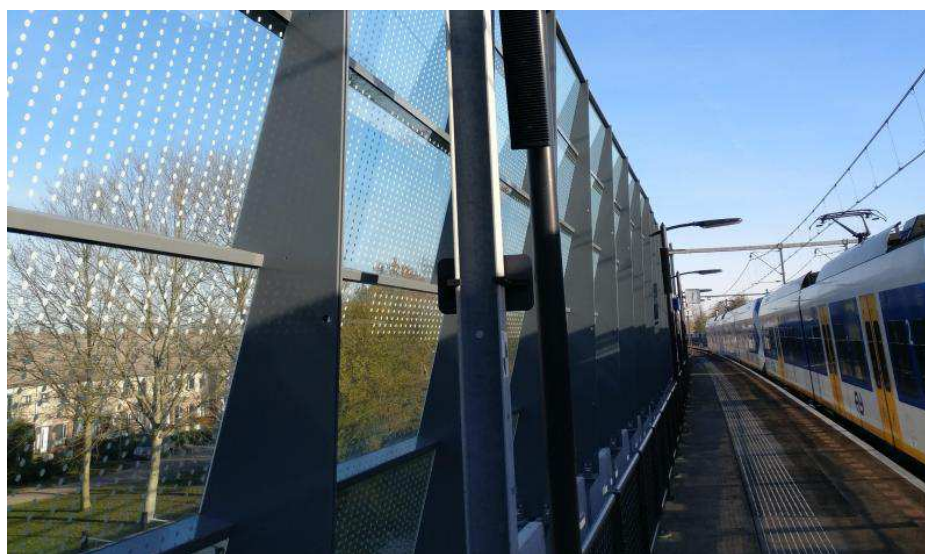


Figure 8-14: Noise Barrier Allowing People to View Surrounding Landscape

6. *Brightness of the light must be controlled* – the brightness from stations, depot and alignments shall be controlled to ensure the light is not perceived as visual blight or pollution to the surrounding areas.
7. *Screen and buffer the structures from people and visually sensitive areas* – the areas or structures that are visually sensitive must screened and buffered from public viewing. It is recommended that the screen and buffer strategies and materials are made up of soft landscape or green materials.



Figure 8-15: Use of Vegetation to Screen View to HSR Structure

8. *Control commercial advertisement at the structures* – commercial advertisement and structures must be control to ensure they have certain design style and conform to architecture needs. In addition, the commercial advertisement shall be seen as not dominating a particular area. The control can be in term of font size, graphic image, and size of the advertisement and lighting aspects. Avoid advertisement materials in or near the natural areas such as forest, parks as well as public spaces. It is recommended that the project proponents identified the specific areas for advertisement along the HSR development corridor.
- ii. *Restore* refer to the visual mitigation measures that can enhance of the visual quality of the site by employing these techniques:
 1. *Restore the site by re-vegetation of native plants* – the soft landscape materials that proposed for a particular site must be native plants because the plants are compatible with Malaysian environmental context and culture.
 2. *Bring vegetation to be as close as possible to structures*–the spaces for soft landscape plantings must be adequate and close to the

buildings/structures. For the HSR alignment or track, minimize the use of expose aggregate as surface cover to only appropriate areas. The strategy is to ensure that the structures to be camouflaged with designed landscape or natural settings



Figure 8-16: Plant Vegetation as Close as Possible to Structures

3. *Restore the disturbed area as close as possible to original contour* - the contour that has been destroyed must be redesigned back to follow as closely as possible the original contour. Avoid the berm and platform earthwork design system during restoration process but rather smooth contour and shape.
4. *Use green infrastructure for storm-water system* – minimize the use of conventional concrete drain for storm water management system. A green infrastructure concept is more appropriate for visual management. A Urban Storm Water Management (MSMA) guidelines by the Department of Irrigation and Drainage (DID) must be fully utilized.



Figure 8-17: Environmental and Visual Friendly Storm Water Management System

- iii. Replace refer to the visual mitigation measure that can enhance the visual quality of the site by replacing the landscape character of the site with new architectural design/structures and they include:
 - 1. *Design the structures with unique architecture style* – the design of the buildings and structures must help to enhance or catalyst the areas visual quality. For example, the station design and the bridge over the rivers and riparian areas that are exposed to public viewing.



Figure 8-18: Bridges with Unique Architecture Style to Capture Visual Attention

2. *Provision of public spaces within the structures compound with proper landscape design* – one of the factors that can enhance public preferences for visual environment is the ability for the spaces to attract people to use. Therefore, in order to increase people acceptance for changes and visual preferences is to introduce public spaces in the vicinity of the structures such plaza, viewing zone and small park.



Figure 8-19: Public Spaces at the Station and to Increase Visual Affordance

3. *Provide connection with the surrounding spaces* – connection of the HSR structures especially the station with surrounding areas also can increase people acceptance for HSR development. The connection strategies such as pedestrian walkways to surrounding neighborhoods (where applicable) will be perceived as increase a place functions to people thus increasing the aesthetic values.



Figure 8-20: Integrating Public Amenities with HSR Structures

4. *Decoration of structures (viaducts) with artwork* – HSR structures especially viaducts are exposed to public viewing and there is an opportunity for the viaducts column or wall to be enhanced with artwork that relates to local culture and crafts.



Figure 8-21: Integration of Art and Structures

5. *The use of green infrastructures such as green wall and green roof* – the structures shall incorporate green wall and green roof (where

applicable) to make them blend with surrounding natural environment and to increase natural elements.



Figure 8-22: Use of Green Walls to Camouflage Structures

b) Visual Mitigation Measures During Construction

During the construction phase, many aspect of visual environment will be affected. Therefore, to ensure there is minimal disturbance to the visual environment, visual mitigation measures shall be carried out at the HSR development site during construction phase, the mitigation approaches include:

- i. Screen construction site from the public viewings – the construction site must be screened from public viewers by fences or hoarding boards. The screening tools can be either in the form of hard material or soft landscape or combination of both.
- ii. Storage and equipment facilities must be screened and buffered – if the site has special areas for storage, the store must also screened and buffered from public viewing with fences or hoarding board.
- iii. Screening features must be decorated – the screening features such as fences and hoarding boards must be decorated with images that reflect the

development of the area or HSR project. Artist impression of the development as well as the development information is one of the suitable decoration materials for screen.

- iv. Point of access to the construction site must be control and enhanced – by controlling the access point, the visual quality of the construction will be better managed. The access point must be clear designed as a proper entrance statement. The access point also shall be enhanced with soft landscape features.

c) Visual Mitigation Measures During Operational

Upon the completion of the HSR development, the mitigation measures must be monitored and managed to ensure the mitigation measures is successful and meet the objectives. Among the measures that need to be taken after constructions are:

- i. Needs of natural landscape maintenance plan – there is a need to have maintenance and operational plan for the visual mitigation measures involving natural areas such as wetlands and forest. The plan need to address maintenance and operational needs to ensure the measures is successful and do not affect the operation of HSR train.
- ii. Needs of detail landscape maintenance plan – for the areas that are not in natural areas, there is a need to have detail landscape design maintenance and operational plan for the visual mitigation measures. The plan need to address maintenance and operational needs to ensure the measures is successful and do not affect the operation of HSR train.
- iii. Regular maintenance operation – regular maintenance operation activities are needed and scheduled such as repainting of structures, replanting of vegetation, replacement of artworks and control of advertisement materials.
- iv. Elicitation of public feedbacks – public opinions about visual quality after construction need to be gauged regularly (at least once a year). It is to ensure that the visual quality of the areas meeting public needs and do not deteriorate after some time.

d) Compliance with Laws and Guidelines

During the mitigation process it is also very important to ensure that detail design follows all the laws, state enactments, local by-law and guidelines that have been enacted in relation to landscape development and visual quality. Among the laws are:

- i. Act 172 (Town Planning Act 1976) – provision regarding site characters and tree provision order (TPO) before Kebenaran Merancang (KM/DO) can be obtained.
- ii. Act 133 (Road and Drainage Act 1974) – provision for building/infrastructure development submission and approval that require Building and Landscape Plan be submitted and approved.
- iii. Act 645 (National Heritage Act 2005) – to check and to ensure that HSR development will not compromise the structures, sites or a person with cultural and heritage significant.
- iv. Respective Structures and Local Plans – these planning control documents, commissioned under Act 172, outlined the needs for any development to adhere states and local needs. Sectors regarding to landscapes, land use and environment must be reviewed and the suggestion must be complied with.
- v. Local authority requirement especially in relation to landscapes and greenery – Local requirement or local by-laws in relation to landscape plants, maintenance and operation must be followed.

All landscape characters were analyzed for appropriate mitigation measures and strategies for before, during and after construction phase (see **Appendix 8D** for each federal territories and states mitigation measures). However, site specific mitigation measures shall also been imposed to particular areas especially the areas with major adverse impacts and with HSR development structures such as stations and maintenance depot.

8.13.2 Specific Mitigation Measures

The detail impact assessment reveals that there are 28 landscape characters areas that categorized as having major adverse visual impact. In summary there are none in the Federal Territory of Kuala Lumpur and Federal Territory of Putrajaya, 12 areas in Selangor, three (3) areas in Negeri Sembilan, six (6) areas in Melaka and four (4) areas in Johor. It is noted that the areas are not isolated so they were grouped into several zones according to the states (**Table 8-10**). These areas and zones need specific visual mitigation measures as they possess high visual quality and the development near them will have an adverse visual impact meaning it will loss the landscape characters quality that they currently have. In addition to the 25 sites, it is also necessary to review the mitigation measures to sites proposed to be depot, stations and terminus stations because the development of those structures is massive and might change the existing visual environment even though the sites categorized as having minor adverse and adverse impacts only.

Table 8-10: Areas with Major Adverse Impacts

| States | Location and Zone | Landscape Characters Segments | Description |
|-----------------|-------------------------------------|-------------------------------|---|
| Selangor | UPM - Serdang Pastoral | 18 | Multi-level residential and commercial with unorganized landscape |
| | | 20, 23 | Institutional with semi-natural landscape |
| | | 24, 26 | Institutional with hilly pastoral landscape |
| | | 27 | Institutional with agricultural landscape |
| | | 28, 37 | Transportation with semi-organized and scenic landscape |
| | UNITEN - Bangi campus areas | 38 | Institutional with organized landscape |
| | | 39 | Institutional with recreational landscape |
| | | 43 | Institutional with unorganized landscape |
| | Sepang natural hilly forested areas | 51, 53, 56 | Vegetated hilly semi-natural landscape |
| | | 54 | Institutional with semi-natural landscape |
| | | 55 | Non-traditional village with semi-natural landscape |
| Negeri Sembilan | Kota Sierramas green open spaces | 9 | Vegetated barren landscape |
| | | 10 | Institutional with semi-organized landscape |
| | | 11 | Recreation with organized landscape |

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| States | Location and Zone | Landscape Characters Segments | Description |
|--------|---|-------------------------------|--|
| | Residential areas of Felda Labu Sendayan | 20 | Semi-traditional village with semi-natural landscape |
| Melaka | Kg Solok Air Limau | 5 | Traditional village with agriculture landscape |
| | Sg Melaka near Kg Pulau and Kg Solok Air Hilir | 13 | Riparian landscape |
| | Ayer Keroh | 21 | Recreation with barren landscape |
| | | 23 | Transportation with organized landscape |
| | | 25 | Commercial with organized landscape |
| Johor | Kg Raja – SMK Sultan Alaudin Riayat Shah, Pagoh | 22 | Semi traditional village with agricultural landscape |
| | Wetlands and aquaculture area, Gelang Patah | 74 | Swamp forest landscape |
| | Estuaries and the Straits of Johor | 83 | Swamp forest landscape |
| | | 84 | Estuary landscape |

8.13.2.1 FT. Kuala Lumpur

There is no area in FT. Kuala Lumpur that is categorized as having major adverse impacts but the visual quality at the proposed site of the Bandar Malaysia Station needs to be mitigated. The station will be major node for HSR development as well as Kuala Lumpur city so it is very important to make sure station is visually pleasing.

Table 8-11: Mitigation Measures for Bandar Malaysia Station

| Background |
|--|
| <p>Bandar Malaysia Station is proposed to be developed at Bandar Malaysia which is on the former Malaysian Royal Air Force camp and airport.</p> <p>Landscape Character Nos: 1, 2, 3, 4, 5</p> <p>General landscape Impacts: Moderate and Low</p> <p>Detail Landscape Impacts: Adverse and Minor Adverse</p> |

Specific Mitigation Measures

The site is potential to be a landmark for HSR development therefore, the station must be designed properly by taking into consideration

- a. Unique architecture style and façade
- b. Proper and adequate landscape design. The landscape design must be able to camouflage the station with greenery and changed the perception that transportation infrastructure is more than an industrial facility
- c. A structure that people can appreciate in term of visual as well as usability

8.13.2.2 Selangor

There are three (3) areas in Selangor that are categorized as having major adverse impacts and they are UPM – Serdang, UNITEN – Bangi and Sepang natural hilly forested areas. Nevertheless, the specific mitigation measures will also include Sepang-Putrajaya Station.

Table 8-12: Mitigation Measures for Light Depot and Light Maintenance Base at UPM-Serdang

Background

Light Depot and Light Maintenance Base at UPM-Serdang is proposed to be developed on institutional hilly pastoral landscape

Landscape Character Nos: 18, 20, 23, 24, 26, 27, 28, 37

General landscape Impacts: High and Moderate

Detail Landscape Impacts: Adverse and Major Adverse

Specific Mitigation Measures

The UPM-Serdang site is highly unique in term of visual quality and sensitivity as well the uniqueness not only for Serdang but also the region. It is also synonym with UPM as a symbol for an agriculture institute. The development of the depot and maintenance base will totally change the visual quality of the areas. It is suggested that HSR development to compensate the loss of the landscape characters of the areas if not avoid the area totally. Placement of depot and maintenance base in other areas is recommended.

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Table 8-13: Mitigation Measures for UNITEN-Bangi Areas

| Background |
|---|
| <p>UNITEN – Bangi Areas is proposed to have HSR structures alignment of viaducts. The areas have building with unique architecture and recreational areas</p> <p>Landscape Character Nos: 38,39, 43</p> <p>General landscape Impacts: High</p> <p>Detail Landscape Impacts: Major Adverse</p> |
| Specific Mitigation Measures |
| <p>The HSR development is within UNITEN, Maybank and other several institutions. Efforts must be taken to ensure that the HSR structures do not be in contrast with surrounding architecture values and style.</p> |

Table 8-14: Mitigation Measures for Sepang-Putrajaya Station

| Background |
|--|
| <p>Sepang-Putrajaya Station is proposed to be developed on non-traditional village and undulating/valley landscape areas</p> <p>Landscape Character Nos: 44, 45</p> <p>General landscape Impacts: Moderate and Low</p> <p>Detail Landscape Impacts: Adverse</p> |
| Specific Mitigation Measures |
| <p>The site is potential to be a landmark for HSR development in Selangor therefore, the station must be designed properly by taking into consideration</p> <ol style="list-style-type: none"> Unique architecture style and façade but to conform the design with surrounding architecture style Proper and adequate landscape design. The landscape design must be able to camouflage the station with greenery and changed the perception that transportation infrastructure is more than an industrial facility A structure that people can appreciate in term of visual as well as usability Public feedbacks about visual quality of the site are necessary because the site is located within the village area therefore constant engagement is needed. |

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Table 8-15: Mitigation Measures for Sepang Natural Hilly Forested Areas

| Background |
|--|
| <p>A Sepang natural hilly forested area is proposed to HSR structures of Elevated, At-Grade and Tunnel. The original characters are hilly and forested.</p> <p>Landscape Character Nos: 51, 53, 54, 55, 56</p> <p>General landscape Impacts: High</p> <p>Detail Landscape Impacts: Major Adverse</p> |
| Specific Mitigation Measures |
| <p>The HSR development will have At-Grade, Tunnel and Elevated Structures on site. The most impacted zone will be at grade zone. It is important for the alignment to blend with surrounding green forest areas.</p> |

8.13.2.3 Negeri Sembilan

There are two (2) areas in Negeri Sembilan that are categorized as having major adverse impacts and they are Kota Sierramas and residential areas of Felda Labu Sendayan. The specific mitigation measures will also include Seremban Station.

Table 8-16: Mitigation Measures for Kota Sierramas Green Open Spaces

| Background |
|---|
| <p>Kota Sierramas is proposed to have HSR Structures of Elevated type. The site is organized residential areas within the vicinity of recreational areas such as golf courses and club houses</p> <p>Landscape Character Nos: 9, 10, 11</p> <p>General landscape Impacts: High</p> <p>Detail Landscape Impacts: Major Adverse</p> |
| Specific Mitigation Measures |
| <p>The HSR development is at Kota Sierramas will traverse through high end residential and recreational areas. Efforts must be taken to ensure that the HSR structures do not visually in contrast with surrounding architecture values and style or blocking people to use the existing recreational facilities.</p> |

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Table 8-17: Mitigation Measures for Felda Labu Sendayan Residential Areas

| Background |
|---|
| <p>A Felda Labu Sendayan area is proposed to have HSR structures alignment of Elevated structures. The areas have unique semi traditional (Felda settlement typology) and blended with orchards and ponds.</p> <p>Landscape Character Nos: 20</p> <p>General landscape Impacts: High</p> <p>Detail Landscape Impacts: Major Adverse</p> |
| Specific Mitigation Measures |
| <p>The HSR development is within Felda settlement which already developed into semi traditional village. Need to ensure that apart from the affected areas, other areas' landscape characters in the village will remain the same.</p> |

Table 8-18: Visual Mitigation Measures for Seremban Station

| Background |
|--|
| <p>Station Seremban is proposed to be in the areas with agriculture landscape.</p> <p>Landscape Character Nos: 14</p> <p>General landscape Impacts: Low</p> <p>Detail Landscape Impacts: Minor Adverse</p> |
| Specific Mitigation Measures |
| <p>The site is potential to be a landmark for HSR development in Negeri Sembilan therefore, the station must be designed properly by taking into consideration</p> <ol style="list-style-type: none"> Unique architecture style and façade but to conform with surrounding architecture and Negeri Sembilan Culture Proper and adequate landscape design. The landscape design must be able to camouflage the station that always be perceived as industrial facilities A structure that people can appreciation in term of visual as well as usability |

8.13.2.4 Melaka

There are three (3) areas in Melaka that are categorized as having major adverse impacts and they are Kg. Solok Air Limau, Melaka Station and Sg. Melaka near Kg. Pulau and Kg. Solok Hilir areas.

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Table 8-19: Mitigation Measures for Kg. Solok Ayer Limau

| Background |
|--|
| <p>Kg. Solok Air Limau areas is proposed to have HSR structures alignment of Elevated and At-Grade. The areas have unique traditional Melaka village character and blended with traditional orchards.</p> <p>Landscape Character Nos:5</p> <p>General landscape Impacts: High</p> <p>Detail Landscape Impacts: Major Adverse</p> |
| Mitigation Measures |
| <p>The HSR development is within traditional Melaka Village. Need to ensure that apart from the affected areas, other areas will remain the same character. Public feedback must be obtain regularly because the areas is within the village</p> |

Table 8-20: Visual Mitigation Measures for Melaka Station

| Background |
|---|
| <p>The Melaka Station in Ayer Keroh is proposed to be built in the areas with highway, vegetated areas and recreation areas</p> <p>Landscape Character Nos: 21,22, 23, 24, 25, 26</p> <p>General landscape Impacts: High and Moderate</p> <p>Detail Landscape Impacts: Adverse and Major Adverse</p> |
| Specific Mitigation Measures |
| <p>The site is potential to be a landmark for HSR development in Melaka therefore, the station must be designed properly by taking into consideration</p> <ol style="list-style-type: none"> Unique architecture style and façade but to conform with surrounding architecture and Melaka Culture Proper and adequate landscape design. The landscape design must be able to camouflage the station that always be perceived as industrial facilities A structure that people can appreciation in term of visual as well as usability <p>The HSR Elevated structures and station platform is planned to cross the road towards Ayer Keroh from PLUS Highway, It is necessary to design the Elevated structure and station to be part and parcel of welcoming statement to Melaka (i.e gateway concept)</p> |

Table 8-21: Mitigation Measures for Sg. Melaka near Kg. Solok Hilir and Kg. Pulau

| Background |
|--|
| <p>Sg. Melaka areas near Kg. Solok Hilir and Kg. Pulau are proposed to have HSR Elevated structures alignment. The areas have riparian and riverine landscapes.</p> <p>Landscape Character Nos: 13</p> <p>General landscape Impacts: High</p> <p>Detail Landscape Impacts: Major Adverse</p> |
| Specific Mitigation Measures |
| <p>The HSR development in this particular part of Sg. Melaka is within vast open riparian areas. The viaduct will be highly visible; therefore, an opportunity for people to view the bridge should be enhanced by providing a proper viewing area (public space). The viaduct that crossing the river must be visible and properly designed with unique architecture style.</p> |

8.13.2.5 Johor

There are three (3) areas in Johor that are categorized as having major adverse impacts and they are Kg. Raja – SMK Sultan Alaudin Riayat Shah, Pagoh, wetlands and aquaculture areas near Gelang Patah and estuaries near to Straits of Johor. Nevertheless, the specific mitigation measures will also include Muar Station, Batu Pahat Station, Iskandar Puteri Station, Heavy Maintenance Base in Muar and Main Depot and Light Maintenance Base in Pontian.

Table 8-22: Mitigation measures for Kg. Raja – SMK Sultan Alaudin Riayat Shah, Pagoh

| Background |
|---|
| <p>Kg Raja – SMK Sultan Alaudin Riayat Shah, Pagoh is proposed to have HSR structures alignment of Elevated and At-Grade. The areas have unique traditional Melaka/Johor village character and blended with traditional orchards. One of the uniqueness of this area is its vicinity to Mausoleum of Sultan Melaka, Sultan Alaudin Riayat Shah that is located at Masjid Lama Kg Raja.</p> <p>Landscape Character Nos: 22</p> <p>General landscape Impacts: High</p> <p>Detail Landscape Impacts: Major Adverse</p> |
| Specific Mitigation Measures |
| <p>The HSR development is within traditional Melaka/Johor village and near to historical site. Need to ensure that apart from the affected areas, other areas will remain the same character. In addition, during the design and construction phase, it has to ensure that the historical areas will not be affected.</p> |

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Table 8-23: Mitigation measures for Wetlands and Aquaculture Areas, Gelang Patah

| Background | |
|--|--|
| <p>Wetlands and aquaculture areas near Gelang Patah are proposed to have HSR Elevated structures alignment. The areas have wetlands, riparian and riverine landscapes.</p> <p>Landscape Character Nos:74</p> <p>General landscape Impacts: High</p> <p>Detail Landscape Impacts: Major Adverse</p> | |
| Specific Mitigation Measures | |
| Specific Consideration | The HSR development in this area is within vast open riparian wetlands. The viaduct shall be blended with the existing wetlands and minimal color and design should be used. |

Table 8-24: Mitigation Measures for Estuarine areas near Tebrau Strait

| Background | |
|---|--|
| <p>The estuaries areas near Tebrau Strait are proposed to have HSR Elevated structures alignment and bridges. The areas have wetlands and riverine landscapes.</p> <p>Landscape Character Nos: 83, 84</p> <p>General landscape Impacts: High</p> <p>Detail Landscape Impacts: Major Adverse</p> | |
| Specific Mitigation Measures | |
| Specific Consideration | The HSR development in this area is within vast estuaries and water bodies. The viaduct shall be design to make it highly visible and unique as a gateway to Malaysia and Johor. |

Table 8-25: Visual Mitigation Measures for Muar Station

| Background | |
|--|--|
| <p>Muar Station is proposed to be in the areas with agriculture landscape.</p> <p>Landscape Character Nos: 20</p> <p>General landscape Impacts: Low</p> <p>Detail Landscape Impacts: Minor Adverse</p> | |

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Specific Mitigation Measures

The site is potential to be a landmark for HSR development for Muar (Northern Johor) therefore, the station must be designed properly by taking into consideration

- a. Unique architecture style and façade but to conform with surrounding architecture and Johor Culture
- b. Proper and adequate landscape design. The landscape design must be able to camouflage the station that always be perceived as industrial facilities
- c. A structure that people can appreciation in term of visual as well as usability

Table 8-26: Visual Mitigation Measures for Batu Pahat Station

Background

Batu Pahat Station is proposed to be in the areas with agriculture and semi traditional village

Landscape Character Nos: 39, 40, 41

General landscape Impacts: Low to High

Detail Landscape Impacts: Minor Adverse to Major Adverse

Specific Mitigation Measures

The site is potential to be a landmark for HSR development for Batu Pahat, therefore, the station must be designed properly by taking into consideration

- a. Unique architecture style and façade but to conform with surrounding architecture and Johor Culture
- b. Proper and adequate landscape design. The landscape design must be able to camouflage the station that always be perceived as industrial facilities
- c. A structure that people can appreciation in term of visual as well as usability

Table 8-27: Visual Mitigation Measures for Iskandar Puteri Station

Background

Iskandar Puteri Station is proposed to be in the areas with agriculture landscapes

Landscape Character Nos: 76

General landscape Impacts: Low

Detail Landscape Impacts: Minor Adverse

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Specific Mitigation Measures

The site is potential to be a landmark for HSR development for Iskandar Puteri and the State of Johor. Therefore, the station must be designed properly by taking into consideration

- a. Unique architecture style and façade but to conform with surrounding architecture and Johor Culture
- b. Proper and adequate landscape design. The landscape design must be able to camouflage the station that always be perceived as industrial facilities
- c. A structure that people can appreciation in term of visual as well as usability

Table 8-28: Mitigation Measures for Heavy Maintenance Base at Muar

Background

Heavy Maintenance Base at Muar is proposed to be developed on agriculture landscape

Landscape Character Nos: 20

General landscape Impacts: Low

Detail Landscape Impacts: Minor adverse

Specific Mitigation Measures

The site is located within agriculture settings and since the use of the facilities will be industry, it is important to screen and buffer the areas from the surrounding areas.

Table 8-29: Mitigation Measures for Main Depot and Light Maintenance Base at Pontian

Background

Heavy Maintenance Base at Pontian is proposed to be developed on agriculture landscape

Landscape Character Nos: 60, 61, 62

General landscape Impacts: Low

Detail Landscape Impacts: Minor adverse

Specific Mitigation Measures

The site is located within agriculture settings and since the use of the facilities will be industry. it is important to screen and buffer the areas from the surrounding areas.

In conclusion, from the impacts analysis, 25 areas were categorized as having major adverse visual impacts and the areas can be found in the State of Selangor, Negeri Sembilan, Melaka and Johor. The impacts are irreversible because the HSR structures will be permanently constructed. Therefore, there is a need to mitigate the impacts of HSR development and consequently soften the changes to the existing visual environment. It is recommended that the impacts to be mitigated during design phase, during construction and operation. For design phase or before construction phase, reduce, restore and replace approaches have been suggested. All the landscape characters segments will receive at least a minimal visual mitigation measures. For 25 areas with major adverse impact, specific mitigation measures were proposed.

8.14 PUBLIC HEALTH

8.14.1 Pre-Construction Phase

The following mitigation measures are recommended in order to ameliorate potential adverse impacts discussed in Chapter 7.

The arrangement and conditions at the new settlement area has to be as good as or better than the previous housing area. The communities should be given a choice to select their preferred home in the new settlement area. The location of homes within the new settlement should also be similar to that of their old housing area, in terms of proximity to their relatives' homes and arrangement according to different ethnicity, if applicable.

Grave yards or cemeteries local to a settlement has to be relocated closer to the new resettlement area for the convenience of caretaking by and/or visitors from the respective communities. The new resettlement area should have similar or better facilities and services as the old housing area. Such facilities include schools, Balai Raya, healthcare services, wet markets, banks and others. Any compensation has to be justified, honest, equal to the current value of the land and satisfactory to the parties that are to be resettled.

8.14.2 Construction Phase

The following mitigation measures are recommended in order to ameliorate potential adverse impacts discussed in Chapter 7 viz:

All workers should be mandated to undergo FOMEMA medical checkup as recommended by the Ministry of Health (MOH), Malaysia. During the checkup, investigation of health history is very important to determine the potential health risks among the workers. They should have symptoms screening and medical examinations conducted at dedicated physician clinics. For tuberculosis, Tuberculin Skin Test (TST) and Interferon Gama Release Assay (IGRA) Test should be conducted together with Chest X-ray that reviewed by a Medical Officer. Additional tests should also be conducted to detect other diseases, including influenza, malaria, typhoid, leprosy, hepatitis B and STIs. This checkup should be done every year for all workers as recommended by the MOH.

The workers of various nationalities should be properly managed in order to ensure a comfortable and safe environment in the base camp and working area. A suitable and trusted person should be selected as a leader to take control of the group's interests and to create a harmonious living environment to prevent social problems among the workers.

Good housekeeping throughout the alignment, all stations and other sites should be maintained clean and managed to prevent any outbreak of communicable diseases such as dengue fever, malaria, filariasis, chikungunya, leptospirosis and food poisoning. The construction sites should have good waste collection systems and regular collection, with collaboration with respective local authorities. Any food serving areas or canteen at sites should maintain good hygiene practices and managed by vaccinated and trained food handlers.

8.14.3 Operational Phase

The following mitigation measures are recommended in order to ameliorate potential adverse impacts discussed in Chapter 7 with regards to Accident, Injury and Safety of Communities viz:

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- The railway tracks, trestles, yards and all equipments should be secured from illegal entry. Walking or playing on them should be prohibited and trespassers should be subjected to prosecution and fines. Walking, running, cycling or the operation of all terrain vehicles (ATV's) on the railway tracks, rights-of-way or through its tunnels should be prohibited.
- No hunting, fishing or bungee jumping from railway trestles should be allowed as the tracks are not designed with sidewalks or pedestrian bridges.
- The perimeter of the railway tracks should be fenced to prevent trespassing or crossing at locations other than dedicated crossing points. In sensitive areas such as schools or towns, an overhead bridge for crossing should be erected to be used by pedestrians and motorcyclists for. People should be allowed to cross the tracks only at designated pedestrian or railway crossings, must be required to observe and obey all warning signs and signals provided.
- Trains passing through identified critical crossing points that serve densely populated areas and sensitive institutions like hospitals, offices and schools should decrease its speed to recommended levels.

The following mitigation measures are recommended in order to ameliorate potential adverse impacts discussed in Chapter 7 with regards to Noise Disruptions to Communities, viz:

The train be required to reduce its speed to a recommended level at critical locations, especially near dense housing areas, hospitals, schools and religious centers (mosques, temples and churches), and braking too late or too close to the recipients should be avoided.

A buffer zone should be provided between the railway tracks and the nearest communities, with adequate distance and presence of trees or any physical barriers that can act as noise shields.

Noise barriers of suitable height and length should be installed at identified sensitive areas along the alignment to reduce the noise exposure to adjacent human settlement or institutions.

- Erection of elevated crossing points is the best practice as the local traffic will not have to stop for the train to pass. This will eliminate the need for the use of the train horn and grade-crossing bell, while also maintaining public safety and emergency vehicle access, and reduce potential local traffic congestion and air pollution.

8.15 RISK

8.15.1 Introduction

The estimated Individual Risk (IR) analysis in the Chapter 7 shows that the public and the population around the HSR Project will not be exposed to any high level risk. However to keep the IR and any residual risks level down the Project Proponent shall institute management procedures which enhance safety on rail.

Once a hazard and its potential causes were identified, the possible consequences are qualitatively evaluated. Any consequence with the potential to cause injury, fatality or multiple fatalities needs to be mitigated.

Where risk was assessed to be Intolerable or Undesirable with the currently proposed safeguards, additional risk reduction, control or mitigation measures were proposed. Where risk was assessed to be Tolerable, the proposed safeguards were reviewed to assess whether they provide sufficient risk reduction. Additional recommendations are proposed where required.

Worker Competency

The importance of workers' competency is never to be under emphasised. It is common knowledge that most accidents are caused by human error. It is therefore necessary to instil safety awareness to the railways' employee right from the start. The training of the employee should include safety procedures and practices. To ensure their alertness and competency are maintained, frequent drilled on emergency response plan should be periodically executed. Derailment and train collision with other trains or objects in part are as a result of driver's error. Over speeding may lead to derailment and failing to follow signal at danger

can cause collisions with other entity. So train drivers should be properly trained to observe train speed limits and to follow other safety procedures. They should be well verse with proper safety rules and regulations.

Maintenance workers either on contract or permanent workers should be ascertained to be well versed with safe work procedures before they are allowed to work on the track. Track work should be less labour intensive to reduce risk exposure. If sufficient increase in train traffic density is established it may justify the installation of automated track safety warning system or a more comprehensive train protection warning system.

Emergency Planning

An Emergency Response Plan should be well devised and regulated to mitigate any emergency situations. Detail procedures and rules should be made available and known to all relevant personnel.

Public Awareness

At some locations, the train traverse heavily populated areas. Residents as the employees and workers near the railway route should be made aware of the existence of the railway within their neighbours. They should be informed periodically or continuously with labels and text boards on what and what not to be done to ensure train and public safety. These measures should be the responsibility of the project proponent so that the public will perceive that the railway operation is as safe as any other everyday activities.

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8.15.2 Construction Phase

Specific hazards, their causes and recommended mitigations measures during the construction phase of the HSR Project is tabulated below.

Table 8-30: Hazards and Mitigation Measures during the Construction Phase

| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|----------------------------|--|---|-----------------|--|
| 1.Lifting/ dropped objects | 1. Precast block dropped (e.g. cable failure, human error) during construction | 1. Traffic interruption before lifting operation | Negligible | 1. Construction method statement must be certified by competent personnel, eg. Professional Engineer (PE). 2. Adequate work supervision and traffic diversion during the process. 3. Emergency Response Plan |
| | | 2. Method statement | | |
| | 2. Gantry falling e.g. Installation error/ removal of gantry. | 1. Traffic interruption during installation and removal of gantry | Tolerable | 1. Contractor to avoid as far as possible installing/ removing gantry over existing railway or major roads. 2. Contractor to as far as possible installing/ removing gantry after railway operating hours 3. Construction method statement |
| | | 2. Method statement | | |
| | | 3. Compliance with railway protection zone regulations | | |
| | | | | |

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| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|-------------------|---|---|-----------------|---|
| | | 1. Traffic interruption during installation and removal of gantry | Tolerable | must be certified by competent personnel, eg. PE. 4. Adequate work supervision and traffic diversion during the process. 5. Emergency Response Planning in place |
| | | 2. Method statement | | |
| | | 3. Compliance with railway protection zone regulations and KTMB's Safety Regulation | | |
| | 3. Gantry failure falling e.g. Overloading and imbalance. | 1. Method statement | Tolerable | 1. Construction method statement must be certified by competent personnel, eg. PE. 2. Adequate work supervision and traffic diversion during the process. 3. Emergency Response Planning in place |
| | | 1. Method statement | Tolerable | |

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| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|---------------------------------|---|---------------------|-----------------|---|
| | 4. Scaffolding falling eg. poor installation, high winds, etc | 1. Method Statement | Negligible | 1. Construction method statement must be certified by competent personnel, eg. PE. 2. Adequate work supervision and traffic diversion during the process. 3. Emergency Response Planning in place |
| | | 1. Method Statement | Negligible | |
| 2. Objects falling off Viaducts | 1. Poor housekeeping during construction | | Tolerable | Adequate supervision |
| | 2. Objects falling from station during construction | 1. Method statement | Negligible | 1. Construction method statement must be certified by competent personnel, eg. PE. 2. Contractor to provide construction nets to prevent objects falling onto the main road. |

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| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|--|---|--|-----------------|--|
| 3. Electrical systems - touch potential/ earthing | 1. Lightning during construction/ local storm. Local storm which could affect construction areas in places where there is no storm through electrical conduction. | 1. Method statement | Tolerable | 1. Construction method statement must be certified by competent personnel, eg. PE. 2. Contractor to develop clear warning and the working procedures under lightning and storm conditions. 3. Emergency Response Plan to address |
| 4. Electrical system - Electromagnetic Interference | Poor quality cable | 1. Technical Specification of materials used in the project. | Negligible | 1. Verification of material quality before acceptance. |
| 5. Unauthorized access - station/ guide way/ Plant rooms | 1. Unauthorized access during construction | 1. Site Security System Plan | Negligible | 1. Contractor to secure the site at all time during construction. 2. Contractor to provide a warning signage to secure construction site. |
| | 2. Unauthorized access during construction around the built up areas. (Higher risk of intrusion). | 1. Site Security System Plan | Tolerable | 1. Contractor to supervise and secure the exit point for construction near built up areas. |

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| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|---|--|--|-----------------|--|
| 6. Wrong routing | Land survey report is wrong | 1.Verification of the land survey report and design | Negligible | 1. The Design specification is verified by the contractors and the Project supervising engineers. |
| 7. Overrun from the guide way | Poor integration of the rail interface | Reliability Assurance Management System (RAMS) | Negligible | 1. System failure testing conducted periodically by the operative |
| 9.Uncontrolled speed/ derailment/ collision | 1. Train signal system failure | Reliability Assurance Management System (RAMS) | Negligible | 1. System failure testing conducted periodically by the operative |
| 14. Dangerous substances/ materials | 1. Poor housekeeping/ use of combustible material | 1. Specific procedure to work with dangerous substances and material | Negligible | 1. Regular monitoring by site supervisor. |
| | | | | 1. Contractor to keep combustible materials offsite for work carried out near existing populated areas |
| 15. Activities near existing railway | 1. Piling work eg. Vibration/ piling machinery access. | 1. Method statement | Negligible | N/A |
| | | 2. Compliance with railway protection zone regulations | | |

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| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|--|--|---|-----------------|--|
| | 2. Exposure/ close proximity to overhead catenaries of existing railway line | 1. Compliance with railway protection zone regulations | Tolerable | 1. Construction method statement must be certified by competent personnel, eg. PE. |
| | | 2. Method statement | | |
| | | 3. Night time construction | | |
| 16. Ground investigation/ excavation/ Tunneling damage to utilities, Existing Buildings and soil level (Cave in) | 1. Piling works for soil investigation | 1. Utilities survey and relocation standard procedure | Negligible | N/A |
| | | 2. Method statement | | |
| | 2. Construction activities damage gas pipelines (small pipelines) | 1. Method statement | Negligible | 1. Any work undertaken under transmission line/ gas pipelines must be supervised by competent personnel from relevant utility company. |
| | | | | N/A |
| | 2. Cut and Cover for Railway Tunnel | 1. Proper utilities mapping to understand existing utilities as water pipe, gas pipes | Tolerable | Construction method statement must be certified by competent personnel, eg. PE. |

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| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|----------------------------|---|---|-----------------|---|
| | | 1. Method statement | Negligible | 1. Adequate Supervision at site. 2. Emergency Response plan |
| | | 1. Soil investigation and analysis 2. Method statement | Negligible | 1. More soil investigation in the required area to find the soil character |
| | 4. Use of TBM for Railway Tunnel. | 1. Instrumentation in TBM to understand the underground status i.e. Inclinometer, Crack gauge, extensometer | Tolerable | 1. Construction method statement must be certified by competent personnel for TBM |
| | 5. NATM technique (blasting procedure employing explosives to move the tunnel face forward) | 1. Method statement | Tolerable | Construction method statement (and blasting sequence) must be certified by competent personnel. |
| 17. Machinery | 1. Crane/machinery unsecured | 1. Method statement 2. Machinery inspection report | Negligible | 1. Regular monitoring by site supervisor. |
| 18. Dust/ noise/ vibration | 1. Piling works | 1. Control vibration monitoring | Negligible | 1. Contractor to consider selection of method to minimize the vibration in close proximity. |

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| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|--|--|--|-----------------|--|
| | 2. Noise generated during construction | 1. Safe noise level specified | Negligible | N/A |
| | | 2. Noise monitoring during construction | | |
| | | 3. Method statement | | |
| | 3. Generation of dust during construction | 1. Method statement 2. Environment Monitoring report | Negligible | N/A |
| | | | | 1. Contractor to consider wetting the soil in close proximity in build-up areas |
| 19. Structure collapse | 1. Integrity of the built structure | 1. Method statement 2. Material Quality Reporting | Negligible | 1. Structures built as per the specification and inspection of the structure as per specification. |
| 20. Subsidence/ ground movements/ etc. | 1. Potential subsidence to existing track during construction. | 1. Method statement | Tolerable | 1. Construction method statement must be certified by competent personnel, eg. PE. |
| | | 1. Method statement | Tolerable | |
| 21. Adverse environment conditions | 1. Earthquakes | 1. Not earthquake zone, compliance with earthquake design guidelines | Negligible | N/A |

CHAPTER 8: MITIGATION MEASURES

| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|---------------------------|--|---|-----------------|---|
| | 2. Thunder storm combined with drain blockage/ overloading of drain system | 1. Operating procedure to clear drains | Undesirable | 1. To review drain capacity at detailed design and increase the capacity where necessary |
| 22. Traffic | 1. Improperly cleaned vehicles from construction area to public areas | 1. Environmental Management Plan to monitor the condition of the vehicles before leaving the project site | Tolerable | 1. Contractor to develop traffic regulation and control plan 2. Contractor to ensure cleaning of the vehicles before leaving the site. |
| | 2. Improper loading/ unloading from construction area | 1. Traffic Management Plan | Tolerable | 1. Contractor to develop traffic regulation and control plan |
| | 3. Improper management of Heavy construction vehicles ingress/ egress | 1. Traffic Management Plan | Tolerable | 1. Contractor to develop traffic regulation and control plan |
| | 4. At station exit by road vehicle | 1. Traffic impact assessment | Negligible | 1. Contractor to develop traffic regulation and control plan |
| | 5. Construction access/ restriction along major roads. | 1. Traffic impact assessment | Tolerable | 1. Contractor to develop traffic regulation and control plan |
| 23. Evacuation/ emergency | 1. Fire during construction | 1. Emergency Preparedness and Response plan | Tolerable | 1. Educate personnel to manage Emergency Response Plan at work site. |

CHAPTER 8: MITIGATION MEASURES

| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|------------------------|---|---------------------|-----------------|--|
| | | 2. Hot work permit | | 2. Contractor to develop emergency plan and procedure. Ensure the contractor provide necessary fire services during construction eg. fire extinguishers etc. |
| 24. Working over Water | 1. People / Material drop into water (river) while working above water surface. | 1. Method Statement | Tolerable | 1. Method statement addresses the requirement of workers wearing flotation device while working over water. 2. Emergency Response plan to assist fallen person to shore. 3. Any material drop to be cleared at the soonest to prevent unwanted incidents to the river users. |

CHAPTER 8: MITIGATION MEASURES

8.15.3 Operational Phase

Specific hazards, their causes and recommended mitigations measures during the operational phase of the HSR Project is tabulated below.

Table 8-31: Hazards and Mitigation Measures during the Operational Phase

| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|---|---|--|-----------------|---|
| 1. Objects falling off Rolling Stock/ Guide way/ Others | 1. Objects falling from station bridge during operation [generic for footpath bridge station] | 1. Method Statement | Undesirable | 1. The operation procedure for Rolling Stock maintenance. |
| 2. Electrical systems - touch potential/ earthing | 1. Potential intrusion along the guide way | 1. Intrusion detection provided and restricted access | Negligible | 2. Periodic Inspection of the line for protection of Earthing issues. |
| | 2. Potential intrusion into the substation | 1. Intrusion detection provided and restricted access, eg. lock devices. | Negligible | N/A |
| | 3. Lightning during operation | 1. Lightning arrestor provided during operation along the guide way. | Negligible | Inspection of the Lighting arrestors |

CHAPTER 8: MITIGATION MEASURES

| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|---|---|---|-----------------|--|
| 3. Electrical system – Electromagnetic Interference | 1. EMI from the transmission line to the railway affecting railway system (transmission line running parallel to the railway) | | Undesirable | 1. Electromagnetic Interference Study to be carried out by E&M contractor. |
| 4. Overrun | 1. Potential Rolling Stock overrun due to system failure | 1. Buffer stop provided | Tolerable | N/A |
| | | 2. Automatic Train Protection (ATP) | | |
| | | 3. Low speed limit at area of concerns eg. Cross over, depot, and station approaches. | | |
| 5.Overspeed/ derailment/ collision | 1. Potential collision | 1. Automatic Train Protection (ATP) | Negligible | N/A |
| | | 2. Manual Operation monitored by ATP. | | |
| | | 3. Low speed limit at area of concerns eg. Crossover, depot, and station approaches. | | |

CHAPTER 8: MITIGATION MEASURES

| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|-----------------------|---|---|-----------------|---|
| | 2. Broken rail/ rail fitting | 1.Rail integrity checks during operation | Negligible | N/A |
| | | 2.Standard Operating Procedures (SOP) | | |
| | 3. Malfunction of switches | 1. Automatic Train Supervision System. | Negligible | N/A |
| | | 2. Standard Operating Procedures (SOP) | | |
| 6. Rolling Stock fire | 1. Rolling Stock on fire arriving at station (open / in Tunnel) | 1. Fire alarm detection | Negligible | Periodic evacuation drill for the employees to ensure they know what they need to do in case of fire emergency. |
| | | 2. Automatic Train Protection (ATP) prevent Rolling Stock to reach station | | |
| | | 3. Fire escape system well designed within the tunnel to prevent any fatality | | |
| | | 4. Open station design | | |

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| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|-----------------------|--|---|-----------------|---|
| 7. Station fire | 1. Station fire e.g. plant room fire | 1. Fire alarm detection | Negligible | Periodic evacuation drill for the employees to ensure they know what they need to do in case of fire emergency. |
| | | 2. Non-combustible material NFPA130 | | |
| | | 3. Evacuation to comply with NFPA 130 | | |
| | | 4. Open station design | | |
| | | 5. Passenger escape to safe area | | |
| 8. Passenger behavior | 1. Smoking inside the station causing fire | 1. Smoke detectors 2. Warning and signage | Tolerable | N/A |
| | 2. Intrusion of passenger into the guide way | 1. Falling objects detector on track at station | Negligible | N/A |
| | | 2. Warning and signage | | |
| | | 3. Controlled paid area | | |

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| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|------------------------------------|--|--|-----------------|---------------------------|
| 9. Dust/ noise/ vibration | 1. Noise generated by the rail vehicles | 1. Safe noise level specified | Negligible | N/A |
| | | 2. Noise monitoring during operation | | |
| | | 3. In build-up areas, noise barriers are provided | | |
| | 2. Generation of dust/ noise during maintenance eg. grinding | 1. Dust is typically contained within the guide way | Negligible | N/A |
| | | 2. Grinding to be maintained outside operating hours | | |
| | | 1. Grinding to be maintained outside operating hours | Negligible | |
| 10. Adverse environment conditions | 1. Earthquakes | 1. Not earthquake zone, compliance with earthquake design guidelines | Negligible | N/A |

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| Hazard Categories | Causes | Mitigation Measures | Risk Categories | Additional Recommendation |
|-------------------|--|--|-----------------|--|
| | 2. Thunder storm combined with drain blockage/ overloading of drain system in Urban environment. | 1. Operating procedure to clear drains | Tolerable | 1. To review drain capacity at detailed design and increase the capacity where necessary |

The average Individual risk during the construction and installation stage is 1.16×10^{-4} and the average Individual Risk for the HSR Project itself is 2.18×10^{-9} . The values are relatively high for construction and operational phase but it is a typical IR level for construction activities. The suggested tolerance level by the UK Health & Safety Executive (UK) (2001) if considered would allow the IR level to be acceptable. To ensure no accidents or unwanted consequences, strict safety practices should be adhered to at all times. The IR for the HSR Project itself is estimated to be 2.18×10^{-9} . This is well below the voluntary risk recommended in the DOE (DOE, 2004) guideline. This IR range is reasonable as most countries particularly in the European continent show similar magnitude. Thus, it reasonable to conclude that the implementation of the HSR Project is safe and would not pose any unnecessary danger to the population at large and should put the public at ease.

8.16 OTHER REQUIRED MITIGATION MEASURES

8.16.1 Surveys, Designs and Studies Pre-Construction Phase

Project designs have been on the whole tailored towards minimizing environmental impacts that could occur during the construction and operation phases of the HSR Project. The protection of the external environment, i.e. receptors located beyond the HSR alignment boundaries, have been given due consideration especially in view of the fact that (a) residential developments exist in close vicinity of the alignment and (b) the vulnerability of the Sg. Labu, Sg. Langat and Sg. Semenyih to adverse water quality shifts arising from pollution loads discharged to its watercourses especially during drought periods.

A preliminary LD-P2M2 plan has been prepared by the Environmental Consultants to control excessive erosion of soil particles from within the HSR alignment. This aspect has been discussed in Chapter 7. The PDP is expected to engage a Certified Erosion and Sediment Control professional to prepare a detailed LD-P2M2 and submit the same to JPS for approval. The alignments and design features of temporary cut-off and permanent storm drains, as well as connections to silt traps, will be identified in the Detailed Plan. Suitable silt traps that are capable of retaining as much of the eroded solids as possible, and their placement will also be delineated in the final Plan.

Appropriate sites for disposal of waste construction materials shall be identified, and if necessary stipulated in Contract specifications. In this respect, close liaison with the Department of Environment, the Ministry of Health and the Local Authorities shall be maintained in order to select suitable dumping site(s), in neighbourhood areas.

8.16.2 Environmental Impact Studies

The environmental mitigation and abatement measures identified by the designers, together with other measures identified in this EIA Study as well as additional control and amelioration measures imposed by the Department of Environment and other Government agencies, shall be integrated into the final designs of Project elements, and in developing operational strategies for various HSR Project functions.

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An Environmental Management Plan (EMP) shall be evolved to guide and ensure an environmentally friendly execution of various construction and operational activities. The EMP shall incorporate mitigation and abatement measures identified in this Study, and those that are required by the Department of Environment (DOE) and other Government agencies and statutory bodies. This is to ensure that the Contractors price their Tenders incorporating costs associated with having to plan, implement and execute specific environmental protection measures, and environmental monitoring schedules, throughout the Construction Period. The PDP shall establish an Environmental, Health and Safety (EHS) team within its overall construction organisational structure to ensure effective reporting of environmental receptor monitoring findings, and to put into effect adequate follow-up procedures to offset any deviations from set objectives. The documentation of the Environmental Management Plan (EMP) shall follow the specific reporting guidelines as established by the Department of Environment Malaysia.

Operating procedures shall be evolved incorporating environmental protection measures and emergency response plans, as recommended in this EIA Report, and those required by the DOE. The Project Proponent and their Railway Operators (RO) shall evolve a comprehensive, integrated environmental surveillance and monitoring strategy. This would include delineating the scope of air, water, noise vibration and waste disposal monitoring programmes on a periodic basis, and establish an organizational structure to ensure effective reporting of findings, and to put into effect adequate follow-up procedures to offset any deviations from set objectives. The recommended monitoring and surveillance measures, which are specified in Chapter 10 of this EIA report, should be incorporated in the Operating Schedule.

8.16.3 General Construction Practices

As explained in Chapter 7, there are potentials for activities carried out during the Project's construction phase to impart significant adverse as well as beneficial impacts on the local and regional environments; as well as on the socio-economic fabric of the Nation. Mitigation and abatement measures are therefore required to be adopted to ensure that activities associated with the construction and installation of facilities do not adversely interact with local environmental receptors; especially with respect to degrading ambient air and water qualities, increasing noise and vibration levels, degrading the quality of land areas because of indiscriminate disposal of construction waste material and sourcing of construction raw

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materials (including fill material), disruption of road traffic circulations, retarding the safety, welfare and quality of life of communities, and affecting the viability of other economic activities operating in the local area.

The construction of the Project shall be executed by appointed contractors selected through a competitive tendering process. The role to be played by the Project Proponent during the Project construction phase shall be to oversee, regulate and monitor the performance of the appointed contractors to ensure that all works carried out conform with internationally accepted engineering specifications, criteria and guidelines; internationally accepted best engineering practices, and with the Environmental Management Plan (EMP) to be established by the Project Proponent's Environmental Consultants.

The Project Proponent is able to exert considerable influence in making sure that the appointed Contractors follow and meet specific obligations to protect the environment during the construction of the Project and ancillary works by ensuring that they comply strictly with the Specifications and Conditions contained in the EMP. Hence it is important that the EMP be documented as part of the Performance Specifications developed for the overall construction of the Project.

In addition the following additional general mitigating measures shall be adopted, viz:

- Construction sites are to be well maintained in order to eliminate ponded areas which could act as suitable disease vector habitats.
- All potential activities which could induce fires will be closely supervised.
- Contractors will take all necessary precautions not to interfere with, or cause nuisance and damage to the nearby existing developments located adjacent to the Project Sites. In this respect the Contractor shall be fully aware of, and strictly adhere to, the Project Proponent's safety and emergency procedures associated with construction works carried out within Project Sites.
- Drainage provisions within the Work Sites shall ensure minimal occurrences of ponded water at all times.

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- Construction materials, equipment and plants shall be delivered to site by overland transportation. It should be incumbent on the Contractor to ensure that transportation schedules are properly planned out ahead of time, and that road traffic authorities and the Local Authority are alerted especially when transportation of bulky items by articulated multi-axle vehicles are employed. These measures shall restrict possible nuisance conditions (traffic congestion) and accident risks (collisions) being imposed on public road commuters, and on any roadside pedestrians. Surveillance on the speed of vehicular travel shall be periodically monitored by the Project Proponent's appointed supervising engineers. The Contractor should submit well ahead of time a schedule for transportation of bulky equipment from source to Project Sites.

To avoid interfering with through flow traffic, the Project Proponent shall establish safe and proper ingress/egress junction arrangements for vehicles to enter and leave the Project Sites. This is to enable construction vehicles to avoid causing traffic encumbrances.

It will be incumbent on the Contractor to employ suitable well maintained vehicles to deliver the necessary materials and plants. In this respect, compliance to tariff load restrictions shall be enforced in order to avoid structural damages to road surfaces, bridges and culverts. In any case, the Project Proponent (and the appointed contractors) shall assume responsibility to redress road pavement damages that are proven to be induced by Project-related vehicles.

- Traffic barriers shall be used for the protection to workers and public during construction. Traffic barrier types shall be either;
 - Triton TL-2 barriers
 - Traffic barriers
 - Barricades
- Construction signing, lighting and barricading shall be provided during all phases of construction as required by the Local Authorities

It is also recommended that the Project Proponent prepare a Traffic Management Plan (TMP) prior to the start of construction works. The TMP must be submitted to

CHAPTER 8: MITIGATION MEASURES

the respective Local Authorities for their approval. The TMP shall be prepared for access roads leading to Project Sites to ensure that no hazards would result from the increased truck and other Project related traffic flows, and that local baseline traffic flows would not be adversely impacted. In the TMP, informational signs would be used to inform the public of temporary traffic hazards. Flaggers' should be employed when Project related machineries and equipment could block throughways, and traffic cones would be used to identify any temporary changes in lane configuration necessary to minimize traffic impacts.

A site preparation execution and management plan incorporating all environmental protection measures should be drawn up by the Contractor and submitted to the Project Proponent for consideration and approval prior to commencing works.

The above procedures and requirements shall be specified in the Civil contracts, in order that Tenderers shall price their bid taking due cognizance of limitations to be imposed on them, and on the special precautions that are needed to be adopted by them in execution of the works.

Toxic and hazardous (i.e. "Scheduled") waste materials (e.g. waste oils, paints, solvents, etc.) will be selectively collected and packaged for convenient disposal to recycling or approved disposal centres following the Environmental Quality (Scheduled Waste) Regulations, 1987.

Suitable arrangements will be made with the regional utility authorities (i.e. Water Supplies and Electricity) in order to procure construction related (temporary) water and electricity needs. Tapping onto public water mains and electrical sub-stations will only be carried out on approval by the respective Authorities. If required, the Project Proponent shall erect a temporary water storage tank within the Site for use by Contractors.

If an on-site electricity generator is to be installed then permission to do so should be obtained from relevant authorities. Oil storage should be adequately regulated and a bund shall encircle the storage tanks, Run-offs from the diesel generator area should be routed to oil traps prior to disposal to off-site storm drains. If necessary, hoardings

shall be erected around the Project Sites in order to mitigate against adverse visual aesthetics.

8.16.4 Centralized Worker Quarters

It should be made mandatory for the Main Contractor, and their appointed sub-contractors, who wish to set-up temporary housing for accommodating immigrant workers to seek appropriate permission from the Project Proponent and the relevant Local Authorities prior to establishing the necessary Centralized Worker Quarters (CLQ).

Approval of site to locate the CLQ shall be issued by the Local Authority. In addition, the State Health, Religious and Police Departments shall be duly informed on the setting up of temporary accommodation facilities so as to maintain effective surveillance over public health, social and security matters.

The Contractor shall ensure that the sites on which the CLQ are established are adequately drained; that adequate provisions are made to collect and treat sewage generated, and to dispose of it in a manner that meets with the approval of the State DOE and Jabatan Perkhidmatan Pembentungan (JPP). Sewage management facilities must be regularly serviced by a licensed contractor to ensure its' efficiency. Suitable measures should be provided to collect and store domestic refuse. Burning of rubbish on-site should not be permitted. Refuse generated at the temporary accommodation should be placed in covered bins and regularly collected by a licensed waste contractor for proper disposal to prevent malodour generation and transmission to neighbouring residential areas. Regular checks by an appointed Project Health, Safety and Environment Officer should be conducted to ensure that the work site is kept reasonably clean and free from vector foraging and breeding sites

It is concluded that appropriate mitigation measures, such as those discussed above, can be inculcated to off-set potential adverse public health and social discords that may eventuate. However, it is recommended that construction CLQ be established external to the Project Work sites. CLQ should be set up prior to the commencement of site preparation activities so as to also accommodate the work force involved during this preliminary activity stage.

8.17 ENVIRONMENTAL PLEDGES

8.17.1 Noise

The EIA has proposed that noise barriers be located at various identified positions along the HSR alignment, which will be confirmed during the Detailed Design stage of the Project through the conduct of a detailed noise assessment study. Details on the type of barrier to be erected (dimensions and material) will be determined during this study.

8.17.2 Vibration

In the absence of detailed soil information along the HSR alignment, prediction of ground borne vibration impacts and propagation to the surrounding receptors will be inaccurate and cannot be reliably predicted. Therefore, a detailed vibration impact analysis will be performed by the Project Proponent during the Detailed Design stage of the HSR Project, details of which will be submitted to the DOE.

A detailed vibration study for the Kuala Lumpur Tunnel shall also be carried out by the Project Proponent when detailed soil data of the area and detailed information on adjacent structures has been obtained to ascertain the scope of mitigation and control measures required to be implemented in order to protect the integrity of adjacent structures.

8.17.3 Waste Management

It's expected that a majority of industrial wastewaters generated at depots and maintenance bases will be recycled (assumed at about 70 %). The recycling-cum-treatment system to be adopted by these facilities can only be confirmed by the Project Proponent. The Project Proponent pledges to the DOE that once details of such systems are confirmed by the Project Proponent, they will be submitted to the DOE for approval in the format and details specified.

The Project Proponent pledges to the DOE that all measures shall be taken to ensure that the water quality of watercourses receiving treated sewage and industrial wastewaters shall not be adversely affected by the discharges.

8.17.4 Soil Erosion

Detailed construction methodology on construction of alignment, stations, depots and maintenance bases will only be finalized during the detailed design stage. As such, the Project Proponent will engage a Certified Professional in Erosion and Sediment Control (CPESC) to prepare a detailed LD-P2M2 as part of the Environmental Management Plan (EMP) to be submitted to the DOE for approval.

The alignment and design features of temporary cut-off and permanent storm drains, as well as connections to silt traps and silt fences will be identified in the detailed plan. Suitable silt traps and silt fences that are capable of retaining as much of the eroded solids as possible, and their placement will also be delineated in the final plan.

8.17.5 Wildlife Management Plan (WMP)

It is not anticipated for the implementation of the HSR Project to have negative impacts on protected wildlife within the Project's corridor. The EIA Study also does not necessitate the need for animal crossings, as the HSR alignment traverses through settlements, oil palm estates and rubber plantations when at-grade.

However, the Project Proponent and the appointed contractor will prepare and implement a Wildlife Management Plan (WMP), with the advice and approval of PERHILITAN. The WMP will address the mitigation of potential impacts towards identified protected wildlife, the provision and design of animal crossings, if deemed necessary, and the mitigation of potential human-wildlife conflicts.

8.17.6 Changes to Alignment and Facilities

The Project Proponent pledge to inform DOE if any changes to the alignment and location of the facilities such as stations, depots and heavy maintenance base. Environmental assessment will be conducted if deemed necessary after the engagement with the DOE.



CHAPTER 9



ENVIRONMENTAL MANAGEMENT PLAN (EMP)



CHAPTER 9: ENVIRONMENTAL MANAGEMENT PLAN (EMP)

9.1 INTRODUCTION

The EIA Report for this Project has identified the potential environmental impacts and key issues that may materialize; namely air quality, water quality, noise, vibration, waste management, ecological, and traffic circulation impacts. Mitigation and abatement measures to ameliorate potential adverse impacts to acceptable levels, and measures to enhance the intensity of beneficial impacts have also been proposed in preceding sections of this Report.

This chapter describes the scope of the Environment Management Plan (EMP) that is relevant for this project. The EMP also includes the legislative requirement to be observed and complied with. Those are given below but not necessarily limited to it:

- Compliance to the Environmental Quality Act (Amendment) 2012.
- Compliance to the Environmental Quality Act 1974 (Act 127) and subsidiary legislation made thereunder.
- To adopt wherever necessary and applicable the Environmental Impact Assessment Guidelines produced by the Department of Environment (DOE) that are relevant to the project.
- Compliance to the Terms and Conditions of Approval that are issued by Authorities for the duration of this project.
- Compliance with all the Malaysian Environmental Guideline produced by the DOE, other relevant authorities and other relevant laws.

The EMP should have a comprehensive monitoring programme, which should take into account the following:

- Monitoring and measurement shall be carried out by trained qualified Technician or accredited laboratory under Skim Akreditasi Makmal Malaysia (SAMM)
- Monitoring and measuring equipment shall be controlled and maintained and a copy of the report shall be handed over to the Employers' Representative and DOE.

The purpose of monitoring is to identify any changes caused by the project activities. It will also establish whether mitigating measures adopted are sufficient to reduce impact. This document is not meant to be a final EMP document for submission to the authority.

CHAPTER 9: ENVIRONMENTAL MANAGEMENT PLAN (EMP)

9.1.1 Objective and Purpose of the EMP

The Environmental Management Plan (EMP) for the Project is intended to be a safeguard measure to ensure that the environmental impacts which were predicted to materialise during the construction and operational phases of the Project are adequately monitored, recorded and analysed. One of the principal aims of an EMP is also to detect and measure actual impacts that materialise on ground, arising from project activities that differ in scope and in magnitude to that predicted in the EIA study. Differences need to be detected early and remedial measures enforced expeditiously to ensure that adverse environmental impacts are mitigated or minimised to tolerable levels as expeditiously as possible. The philosophy is to strike a balance between the development of the Project and environmental protection.

The Objectives of the EMP are to protect, restore and enhance the environmental quality within areas that are likely to be impacted upon by the construction and operations of the Project (i.e. within the ZOI). This is achieved by:

- Compiling and collating data that can be usefully employed to realistically gauge the environmental impacts induced by the construction and operation of the HSR Project.
- Maintain a monitoring of air (CO, CO₂, NO_x and suspended particles) and water pollutant emissions (sewerage and industrial wastewater), solid wastes generation, noise and vibration releases to the environment, soil erosion and sedimentation rates of work areas, and the status of terrestrial and marine ecological systems over the tenure of this Project.
- Establish appropriate standards and procedures for the monitoring of environmental impacts arising from the Project's operations; as well as the performance efficiencies of pollution control plant and equipment
- Verify the HSR Project's compliance with environmental laws, regulations, etc.
- Foster good Project Proponent-Community relationships.

CHAPTER 9: ENVIRONMENTAL MANAGEMENT PLAN (EMP)

- Assign responsibilities for monitoring the environmental compliances that the Project has to meet.

The measures set out in this EMP should be incorporated into the contractual agreements which will be entered into between the Project Proponent and the parties who will be responsible for the construction, installation, erection, the commissioning and thereafter operations of the various components of the Project. In this way, compliance with the measures set out in the EMP may be ensured through the possible imposition of penalties on contractors/operators that are at fault.

9.1.2 Future Review of EMP

In view of the fact that the EIA Report has been prepared in tandem with preliminary designs, this EMP is a guideline that would need to be reviewed once detailed plans are finalized after appointment of the Project Delivery Partner (PDP). The recommendations made in this EMP will need to be reviewed in detail in parallel with the detailed design work for the Project, and with the operational needs and characteristics of the Project as options are selected and firmed up.

9.1.3 EMP Implementation Schedule

The scope of compliance monitoring, performance monitoring and environmental audit programmes that should be instituted during the following three (3) phases of the Project development, namely (a) Phase I – Pre-Construction or Preliminary Stage, (b) Phase II - Construction phase, and (c) Phase III - Operational phase in order to monitor actual impacts induced by Project development and operations in a quantitative manner, and to gauge the effectiveness of mitigation measures, are described in this Chapter.

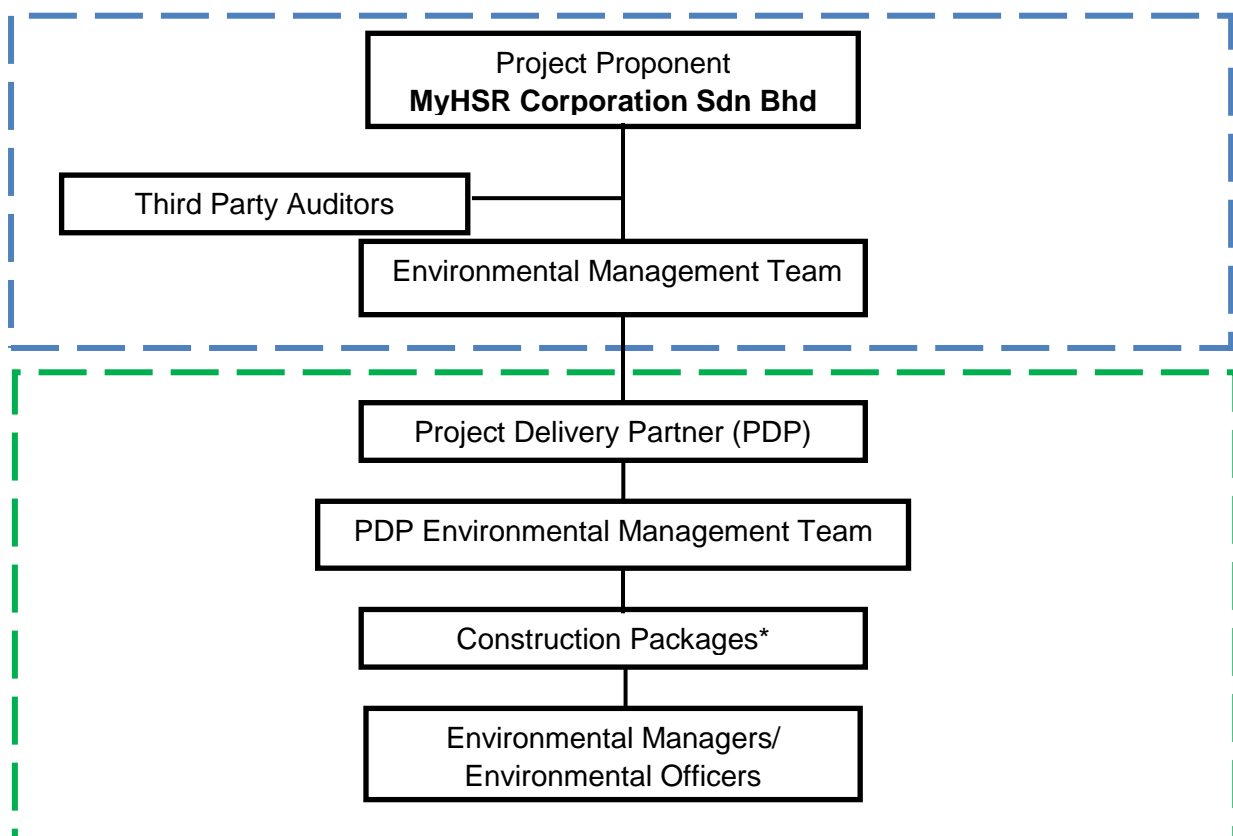
Actual monitoring programmes shall be instituted just prior to and during the construction of the Project; and this shall be carried over throughout the life span of the Project. Environmental audits shall be performed throughout the construction period, and periodically over the Project's operational period.

CHAPTER 9: ENVIRONMENTAL MANAGEMENT PLAN (EMP)

9.1.4 EMP Management Structure

This EMP identifies standards and procedures for environmental management and then assigns responsibilities for implementing and monitoring the relevant impacts. **MyHSR Corporation Sdn Bhd** as the Project Proponent is responsible for the overall project management as well as the environmental performance and compliance of the HSR Project.

The other parties with responsibilities for environmental management and compliance include the PDP, appointed contractors and Environmental Manager / Officers for each construction packages. These parties shall form close and effective liaison with the Federal and State DOE offices throughout the Project's life span. The PDP's Environmental Management Team will report to the MyHSR's Environmental Management Team periodically to update on environmental management, compliance and any queries raised by the DOE.



*Note: * The number of construction packages will be decided during the detailed design stage.*

Figure 9-1: Project Environmental Management Structure

CHAPTER 9: ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Roles and Responsibilities

The environmental responsibilities of all parties, from the top level until the working level, must be clearly stated and defined, as per **Table 9-1**.

Table 9-1: Roles and Responsibilities

| Roles | Responsibilities |
|--|--|
| Project Proponent: MyHSR Corporation Sdn Bhd | <ul style="list-style-type: none"> • To comply with EIA approval conditions and other relevant environmental requirements • To monitor environmental compliance by PDP as per contractual requirements • To ensure actions are taken to address any complaints during construction phase • To submit environmental report to DOE as required in the EIA approval conditions |
| Project Delivery Partner | <ul style="list-style-type: none"> • To comply with the EIA approval conditions and other relevant environmental requirements • To monitor and supervise the implementation of P2M2 • To brief all contractors, sub-contractors and consultants about environmental requirements • To ensure that any complaints with regards to environmental impacts during construction are addressed and acted upon |
| Package Contractors | <ul style="list-style-type: none"> • To implement P2M2 throughout construction phase • To ensure compliance to environmental requirements at all time |
| Environmental Managers/ Environmental Officer | <ul style="list-style-type: none"> • To implement the implementation of EMP and P2M2 • To prepare the Environmental Performance Monitoring Document (EPMD) which will describe compliance and performance of the P2M2 • To supervise and overseas the Performance, Compliance and Impact Monitoring Programme • To prepare the Performance Monitoring Report (PMR) which will evaluate the overall performance of the P2M2 and proposed recommendations to minimise the impacts • To communicate the status of environmental compliance to MyHSR and PDP • To maintain environmental records of any incidences or accidents and all relevant documents during the construction phase |

CHAPTER 9: ENVIRONMENTAL MANAGEMENT PLAN (EMP)

9.1.5 Scope of EMP

The EMP encompasses five (5) main categories of activities, they being:

- (a) Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2);
- (b) Performance Monitoring Programme (PMP);
- (c) Impact Monitoring Programme (IMP);
- (d) Environmental Auditing Programme (EAP).
- (e) Environmental Mainstreaming

There is a need for the EMP to establish effective and efficient **Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2)**. The focus of the LD-P2M2 is on the prevention, mitigation and control of the discharge from the development area containing the major pollutant (suspended solids) resulting from land disturbing activities. Details of Pollution Prevention and Mitigating Measure (P2M2s) for this section are based on the mitigating measures in Chapter 8 and incorporation with the Condition of Approval (COA) of EIA report from DOE.

All relevant parties including Project Proponent, PDP, Contractors, Environmental Mangers / Environmental Officers (EOs) understand LD-P2M2 in order to facilitate compliance with the minimum standards requirements.

All relevant P2M2s especially temporary Best Management Practices (BMPs) at the construction phase are installed and maintained to mitigate the potential pollution due to land disturbing activities. This P2M2 should include step and BMPs of following where applicable to proposed project:

- Schedule of Phasing, Staging and Sequencing
- Schedule Site Meeting
- Construction Markers
- Stabilized Construction Entrance
- Stream/drainage way/waterway/watercourse buffers
- Perimeter control
- Sediment Basin / Trap

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- Runoff Management
- Temporary or permanent watercourse diversion
- Temporary or permanent watercourse crossing
- Temporary or permanent roadways
- Temporary Stabilization
- Stockpile Soil Management
- Spoil Management Area (Disposal Area)
- Dewatering practices
- Active Treatment System (ATS)
- Corrective Actions
- Site Inspections
- Maintenance
- Standard and Specification for P2M2s

Performance Monitoring Programmes (PMP) is of importance as they will assist in complementing the interpretation and deduction of LD-P2M2 data. In this respect, the PMP will focus on ascertaining whether pollution control and abatement equipment and plant, and other structural/non-structural measures, are performing to their design intent. Such a monitoring programme will assist in deducing whether such plant and equipment are contributing towards the deteriorating status of environmental components that are being monitored for their compliance with appropriate standards.

Impact Monitoring Programmes (IMP) is required in order to monitor and assess the actual impacts of the predicted impacts that are uncertain. Such a programme will enable those uncertain impacts to be accurately defined in terms of its extent of impact.

Environmental Auditing Programmes (EAP) is required in order to ensure that the commitments made by the Project Proponent to protect the environment from deterioration and degradation throughout the Project's lifespan, so far as is reasonably practicable, will be fulfilled. The EAP should be undertaken during the development such as construction and operational phase. This would enable the Project Proponent to verify the effectiveness of the system and provide adequate time to incorporate the necessary changes to suit the Project

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Proponent's requirements as well as train the necessary manpower that would be required to implement the EMP for the entire life of the HSR Project.

Environmental Mainstreaming has been integrated into all the recent regulation of the DOE. Self-regulation has been adopted by DOE as a long-term goal to be achieved and a culture to be inculcated within the regulated sectors through mainstreaming of environmental agenda. This approach to pollution control is a win-win concept which has shown to accrue positive results in improved environmental image of companies, increased public acceptability of projects, optimal operation of pollution control systems (PCSs), prevention of PCS failure, cost savings in PCS operation, systematic management of performance monitoring data and improved regulatory compliance on sustained basis. On wider perspective, self-regulation which complements the existing command and control approach of the DOE, would result in cultivating environmental ownership and excellence in environmental commitment and in environmental regulatory compliance from the regulated sectors.

The EMP is to be executed in six (6) stages as described below:

- **Section 9.2** outlines the **environmental mainstreaming** framework to be adopted by the Project Proponent in the implementation of this EMP.
- **Section 9.3** outlines the environmental monitoring requirements that should be followed **pre-construction phase** of the Project.
- **Section 9.4** outlines the environmental monitoring requirements that should be followed during the **construction phase** of the Project; taking due cognizance of the environmental protection requirements needed to ensure compliance with the relevant environmental performance standards established for this Project.
- **Section 9.5** outlines the environmental monitoring requirements that should be adhered to during the **operational phase** (normal or otherwise) of the Project.
- **Section 9.6** outlines the performance monitoring requirements for this Project.

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- **Section 9.7** outlines the environmental auditing requirements that should be adhered to during the **construction** and **operational phase** of the Project.

9.2 ENVIRONMENTAL MAINSTREAMING

Environmental Mainstreaming Elements

A. Environmental Policy (EP)

The policy generated basically represents the Project Proponent's assurance to protect, restore, and enhance the environmental quality at the site. It embodies a set of objectives, which directs the formulation of the EMP.

Project Proponent need to be dedicated towards conservation and protection of the environment and continues to make these initiatives their priorities in their policy decisions which comply with all relevant legislative requirements.

B. Competent Person

It is essential for the Project Proponent to complete the implementation of the Project with minimal impact to the environment. In order to achieve this, designation competent personnel is important to ensure proper planning and communication with DOE is accomplished. Competent person position should be commensurate with their responsibilities. Their roles and responsibility are to facilitate the overall environmental management in term of guided self-regulation documentation and implementation.

C. Performance Monitoring (PM)

Project Proponent must carry out performance monitoring as it is a proactive and preventive monitoring of process to ensure PCSs are optimally operated and maintained. PM should be incorporated as a standard code of practice (SOP) which must be implemented and strictly enforced.

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D. Environmental Performance Monitoring Committee (EPMC)

The successful implementation of Guided Self- Regulation (GSR) requires commitment of all members in the committees of the organisational. EPMC is a permanent committee at the operational level which is established to monitor the construction, operation, maintenance, and performance of PCS, waste reduction targets, etc. This commitment should begin at the highest level of management by formulating an organisational structure which defines roles, responsibilities and authorities of each operational management staff toward environmental compliance. The EPMC must meet at a minimum once a month and meeting records must be maintained.

E. Environmental Regulatory Compliance Monitoring Committee (ERCMC)

The committee at the policy level must be set up to monitor the implementation and the effectiveness of environmental policy and for formulating additional policy elements if necessary. Implication of new environmental regulatory amendments, environmental implication of company expansion program, environmental improvement projects, major initiative to address major noncompliance issues, procurement and purchasing policy in relation with environmental implications are subject matters discusses at ERCMC meetings. The company's compliance with all the regulations enforced by the DOE comes under the scrutiny and responsibility of this committee. The ERCMC is chaired by the company's highest level with members comprised of the heads of the departments. The ERCMC must meet once a year and meeting record must be maintained.

F. Record Keeping

A systematic procedure and record keeping system must be established to keep records related to the operation, maintenance and performance of PCS, upset condition and the chemical usage.

G. Data Analysis and Interpretation

The performance monitoring data, compliance monitoring data, upset condition data, and operation and maintenance data must be analysed and presented in suitable format for presentation at EPMC meetings and for decision making purposes.

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H. Discharge Monitoring

Discharge of effluent to the environment must be monitored on a schedule basis and reported according to regulatory requirements. Wherever applicable, real time monitoring system such as equivalent system for effluent monitoring must be investigated for implementation.

I. Reporting and Communication

A reporting procedure and an internal communication channel within the company must be officially established for reporting and communicating environmental performance to the relevant company personnel. This creates companywide awareness and concern for the environment and for environmental performance. Regulatory environmental compliance and excellent performance is an achievement and pride which should be shared among the company staff.

Budget Allocation and Staffing Requirement

Project Proponent needs to allocate sufficient budget for the implementation of the environmental mainstreaming (EM) initiative. Top level commitment in the form of budget allocation is a prerequisite for the success of the initiative.

Implementation Schedule and Monitoring

Top management must understand the environmental mainstreaming (EM) concept and trickle down to those involved in the implementation phase of mainstreaming initiative. The schedule of implementation must be drawn up and EM implementation program monitored by the highest level in the organisation. It is recommended that the EM initiative should be completed within six (6) to 12 months.

Reporting to the DOE

Within six (6) months from the commencement of the implementation of the environmental mainstreaming (EM) initiative, an implementation status report must be submitted to the DOE.

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LD-P2M2 Submission Checklist

All relevant checklist items regarding the Proposed Project need to be identified, addresses, discussed, assessed, evaluated and presented in the LD-P2M2 document. Checklist items are as below:

- Project Activity and Implementation
- Information and Analysis on Project Development
- Map of site plan with the existing site condition (pre-development)
- Map of site development plan

*Note: Details of all above item can be referred in Guidance Document for the preparation of the document on Land-Disturbing Pollution Prevention and Mitigating Measure (LD-P2M2) (Appendix 4 of EIA Guidelines in Malaysia, 2016)

9.3 ENVIRONMENTAL MANAGEMENT PROGRAMME – PRE-CONSTRUCTION STAGE

Pre-construction plans have to be initiated early so that activities which can affect the environment can be identified early and plans for mitigation measures initiated accordingly. The pertinent pre-construction activities that would require adequate planning and prior deliberation should be identified. These activities have been highlighted in the preceding chapters of the main text.

The ad-hoc monitoring undertaken by the EIA Consultant during the course of this EIA study would constitute the monitoring programme for the preliminary stage. The parameters and the locations of these monitoring points are indicated in **Chapter 6**. The selection of these sampling stations, and the environmental parameters to be monitored, are based on anticipated impacts induced by the project on the environment within the ZOI. The results from the ad-hoc monitoring would therefore form the baseline data with which the subsequent monitoring results would be compared with to determine the actual real time impacts of the project on the environment. The parameters and sampling stations for the

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subsequent stages of the project shall be similar to that of the ad-hoc monitoring programme to facilitate comparison of data at various stages of the project and to determine the impacts of the project activities on the environment.

9.4 ENVIRONMENTAL MANAGEMENT PROGRAMME – CONSTRUCTION PHASE

9.4.1 Introduction

The EIA Consultants are of the opinion that a detailed Environmental Management Quality Procedure (EMQP) should be drawn up in order to define the environmental monitoring (and management) programmes to be implemented during the construction of the Project. The EMQP will be a series of environmental management guidelines, standards and criteria that will be imposed by the Project Proponent (in liaison with its Consultant) on all contractors involved in the construction of the Project. The purpose of this will be to ensure that satisfactory levels of environmental monitoring and compliance will be achieved during and after all construction activities in or around the project sites have been initiated.

The standards to be established within the ambit of the EMP should be agreed with the relevant authorities and government departments, namely the DOE. It should include the measurement of ambient noise and vibration levels, air and water qualities similar to that carried out under the EIA Study, as well as qualitative studies of other environmental indicators such as land contamination, public health status, ecological status and intensity of traffic circulations and impedances.

9.4.2 General Requirements

The Project Proponent and its appointed contractors will be required to comply with all legal duties and obligations regarding the protection of the environment (in particular, those laid down in the Environmental Quality Act 1974), and further relevant legislation introduced prior to the commencement of construction, and all regulations, standards and guidelines made

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under the purview of such legislation. The Project Proponent will also be ultimately responsible for the implementation of the EMP throughout the construction phase.

A full-time Environmental Manager, employed by the Project Proponent, shall have the authority to regularly monitor the works and to audit construction activities and management practices on site. The Environmental Manager should have the authority to halt any activity found on site causing a breach of the EMQP, until revised working methods have been agreed and implemented.

9.4.3 Construction and Development Activities

Normally the administration of construction contracts rests with the PDP team and therefore the task of environmental monitoring and management during construction will be their responsibility. The EPMC on their part will be assisted by their Environmental Manager. The contractor(s) involved in the construction of the HSR system and supporting facilities have an important role in the management of the environment. The contractor is expected to have particular responsibility in the protection of the environment with regards to (a) air pollution, (b) water pollution, (c) noise and vibration induced pollution, (d) terrestrial and marine ecosystems, (e) traffic management and (f) waste disposal.

9.4.4 Environmental Monitoring During Construction Phase

9.4.4.1 Air Quality

Table 9-2 below describes the standards and procedures for monitoring air quality during the construction phase.

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Table 9-2: Monitoring of Air Quality during Construction Phase

| Issue | Standards and Procedures |
|----------------------------------|--|
| Air quality monitoring programme | <p>The Project Proponent to submit programme for air quality monitoring to the DOE before the commencement of any construction or development activity. Details to be submitted will include locations of the air quality monitoring stations, parameters to be monitored, frequency of sampling, equipment to be used (dust deposition gauges, air samplers) and submission of the monitoring results.</p> <p>The air quality parameters to be monitored should comply to the EIA approval condition. The frequency of monitoring should be once a month or as per the approved EIA condition and the report submitted to DOE once every three (3) months or as per the approved EIA condition. Based on the impact assessment study, the proposed monitoring points are listed in Appendix 9A and Appendix 6J.</p> |
| Submission and Documentation | <p>The Project Proponent shall submit to the DOE State the results of the monitoring programme once every three (3) months or as per the approved EIA condition. Relevant forms and documents should also be submitted for the activities under the Clear Air Regulations 1978 that would require further approval from the DOE. The status of compliance to the Conditions of Approval of the EIA shall be submitted to DOE once every three (3) months (including relevant forms).</p> |

Proposed Parameters to be Monitored

Proposed parameters to be monitored are Total Suspended Particulate (TSP), PM₁₀, NO_x and CO. The air quality standards to be complied with are provided in **Chapter 6**.

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Proposed Frequency of Monitoring

Proposed frequency of monitoring is once a month.

Proposed Location of Sampling Stations

Based on the impact assessment study, the locations of the proposed air monitoring points are given in **Appendix 9A** and **Appendix 6J**. Notwithstanding the above, the Project Proponent shall ensure that the selected parameters, frequency of monitoring and the location of sampling sites are approved by DOE State prior to the commencement of the ambient air quality monitoring exercise.

9.4.4.2 Noise and Vibration

Table 9-3 below describes the procedures for monitoring noise and vibration levels during the construction phase.

Table 9-3: Monitoring of Noise and Vibration Levels during Construction Phase

| Issue | Procedures |
|--|--|
| Noise and vibration level monitoring programme | <p>The Project Proponent to submit programme for noise and vibration measurement to the DOE before the commencement of any construction or development activity. Details to be submitted will include locations of the noise level and vibration monitoring, frequency of monitoring, equipment to be used and routing of the monitoring results.</p> <p>The parameters to be monitored should include those monitored during the tenure of the EIA study. The frequency of monitoring should be at least once a month or as per the approved EIA condition and the report submitted to DOE once every three (3) months or as per the approved EIA condition. The proposed monitoring points are listed in Appendix 9B1 and Appendix 6J.</p> |

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| Issue | Procedures |
|------------------------------|--|
| Submission and Documentation | The Project Proponent to submit to the DOE State the results of the monitoring programme once every three (3) months. Relevant forms and documents should also be submitted for the activities that are expected to generate substantial noise and vibration (including relevant forms). The status of compliance to the Conditions of Approval of the EIA shall be submitted to DOE once every three (3) months (including relevant forms). |

Proposed Parameters to be Monitored

Proposed parameters to be monitored are L_{\max} , L_{10} , L_{50} , L_{90} , L_{eq} , and mm/s for vibration.

The ambient noise and vibration limits to be complied with for this project are identified and listed in **Chapter 6 (Section 6.11.3)**.

Proposed Frequency of Monitoring

Proposed frequency of monitoring is once a month.

It is the recommendation of the EIA Consultant that the noise levels be monitored during day time and night time periods, and where necessary on a 24-hour basis during the construction phase.

Proposed Location of Sampling Stations

The locations of the proposed noise and vibration monitoring points are given in **Appendix 9B1** and **Appendix 6J**. Notwithstanding the above, the Project Proponent shall ensure that the selected parameters, frequency of monitoring and the location of sampling site are approved by DOE State prior to the commencement of the noise monitoring exercise.

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The Project Proponent shall carry out a comprehensive Dilapidation study during the construction stage for structures located 50 m from the railway tracks to ascertain the scope of mitigation and control measures required to be implemented in order to protect the integrity of adjacent structures out of vibration events.

9.4.4.3 Water Quality

(a) River Water Quality and Marine Water Quality

Table 9-4 below describes the procedures for monitoring river and marine water quality during the construction phase.

Table 9-4: Monitoring of River Water Quality during Construction Phase

| Issue | Procedures |
|------------------------------------|--|
| Water quality monitoring programme | <p>The Project Proponent to submit a programme for monitoring river and marine water quality before the commencement of any construction or development activity. Details to be submitted will include locations of the monitoring stations, frequency of monitoring, equipment to be used and routing of the monitoring results.</p> <p>The parameters to be monitored should include those monitored during the tenure of the EIA study. The frequency of monitoring should be at least once a month or as per the approved EIA condition and the report submitted to DOE on a once every three (3) months or as per the approved EIA condition. The proposed monitoring points are listed in Appendix 9C1 and Appendix 6J. Monitoring of effluents discharged from silt traps, introduced at areas of earthworks operations, shall also be carried out by the Contractor.</p> |
| Submission and Documentation | <p>The Project Proponent to submit plans for permanent and temporary construction works and their programme schedule for implementation. The Contractor to implement the</p> |

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| Issue | Procedures |
|-------|---|
| | construction activities according to plan. The Project Proponent is also to submit plans for the construction of sewage and effluent treatment plants to ensure the sewage and industrial effluent is treated to the approved standards prior to discharge (including relevant forms). The status of compliance to the Conditions of Approval of the EIA shall be submitted to DOE once every three (3) months (including relevant forms). |

Proposed Parameters to be Monitored

(a) River water quality

- pH, TSS, Turbidity, DO, BOD₅, COD, Oil & Grease, *E.coli* and NH₃N

(b) Marine water quality

- DO, Total Organic Carbon, TSS, Oil & Grease, Faecal Coliform and NH₃N

The terrestrial and marine water quality standards to be complied with are provided in **Chapter 6**.

Proposed Frequency of Monitoring

(a) River water quality

Proposed frequency of monitoring is once a month.

(b) Marine water quality

Once every two (2) weeks: During the marine construction activities (piling, pier construction)
Once a month: During the remaining construction activities.

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Proposed Location of Sampling Stations

The locations of the proposed water monitoring points are given in **Appendix 9C1** and **Appendix 6J**. Notwithstanding the above, the Project Proponent shall ensure that the selected parameters, frequency of monitoring and the location of sampling site are approved by DOE State prior to the commencement of the water monitoring exercise.

Other Components

Monitoring is not required during the construction phase for the following components:

- 1) Current Speed
- 2) Marine Navigation
- 3) Plankton
- 4) Macrobenthos
- 5) Fish Fauna

(b) Silt Trap Discharge

Inspection of the temporary earth drains, check dam, sediment basins, silt fence and earth bund be carried out immediately after an episode of heavy or prolonged downpour. The LDP2M2 Inspection Checklist shall be prepared specific to the site condition. **Table 9-5** shows the schedule of P2M2 inspection and maintenance during the construction phase.

Table 9-5: Schedule of Inspection and Maintenance

| P2M2 | Type of Maintenance | Frequency of Inspection | Frequency of Maintenance |
|-----------------------|-------------------------------|---|--|
| Temporary Earth Drain | To remove silt and check flow | Once a week inspection after each raining episode | Once every two (2) weeks (1 st week & 3 rd week of the month) |
| Mulch | To reapply gap area | | |
| Close Turfing | To replant at gap area | | |
| Hydroseeding | To reapply at gap area | | |
| Erosion Blanket | To replace damaged section | | |
| Sediment Basin | To remove silt | | |
| Silt Trap | To remove silt | | |

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| P2M2 | Type of Maintenance | Frequency of Inspection | Frequency of Maintenance |
|----------------------|----------------------------|-------------------------|--------------------------|
| Check Dam | To remove silt | | |
| Earth Bund | To repair damaged section | | |
| Silt Fence | To replace damaged section | | |
| Pipe Culvert | To replace damaged unit | | |
| Gross Pollutant Trap | To remove garbage | | |

Proposed Parameters to be Monitored

- TSS and Turbidity

Proposed Frequency of Monitoring

Monitoring shall be carried out based on the following frequency or as specified in the EIA approval conditions:

- Once a month
- Half an hour after 12.5 mm of rainfall

Table 9-6: Environmental Monitoring for Erosion and Sediment Control

| Type of Monitoring | Parameter / Item |
|-------------------------------|--|
| Performance Monitoring | Regular calibration of <i>in-situ</i> water sampling meters such as TSS and Turbidity meter, etc. |
| | Engage service of laboratory with SAMM accreditation with proof of record. |
| | Weekly inspection and after-rain inspection of P2M2. Repair, make-good or replace damaged or unsuitable P2M2. |
| | Corrective action, communication and record keeping. |
| Compliance Monitoring | TSS concentration shall comply with 50 mg/l limit (or as specified in EIA approval conditions) at the discharge point of Sediment Basin and Silt Trap. |
| | Turbidity concentration shall comply with 260 NTU limit (or as specified in EIA approval conditions) at the discharge point of Sediment Basin and Silt Trap. |

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| Type of Monitoring | Parameter / Item |
|--------------------|--|
| Impact Monitoring | Biological indicators such as diminish of existing aquatic species (flora and fauna) after construction commence. |
| | Public complaints due to dust emission, slope failure, mud track from the construction vehicles of the project site, flash flood, etc. |

9.4.4.4 Traffic Circulations

Project-related traffic on arterial and distribution (feeder) road networks around the Project areas will increase and this will affect the present road users. In addition to this, such traffic will also contribute to air and noise pollution. **Table 9-7** below describes the procedures for monitoring traffic during the construction phase.

Table 9-7: Monitoring of Traffic during Construction Phase

| Issue | Procedures |
|--|--|
| Traffic management programme | The Project Proponent will prepare a traffic management programme in order to reduce transport impact associated with the movement of construction related traffic to and from the Project site, especially when involving heavy haulage (i.e. equipment and machinery transport). |
| Monitoring of noise levels and air quality | The Project Proponent to submit programmes for the monitoring at sensitive receptors along the haul roads and public roads. These programmes shall be incorporated into the respective noise level and air quality monitoring programmes. |

The need for monitoring of traffic and its requirements is subject to the requirement and/or approval by the Public Works Department of Malaysia.

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9.4.4.5 Waste Generation and Management

Significant amounts of biomass will be generated during clearing of land areas to accommodate the HSR facilities. In addition some amount of construction debris would be generated during the construction and commissioning stages of the project. The disposal of these wastes unless controlled, can have an impact on the environment. The Project Proponent should prepare a programme for waste management, and strategy for minimization and reuse. The Project Proponent shall inform the DOE as well as the local authority of their plans for disposal of solid wastes off-site (to approve disposal sites). This Plan should be disseminated to the Project's Contractors and Suppliers (producers' responsibility to manage used items of packaging etc.). The Project Proponent should develop a programme to monitor the contractors' efforts in effective waste management.

The Project Proponent should instill a programme to enhance recycling and reuse efforts amongst its contractors and suppliers, and develop a tracking programme to monitor the effectiveness of this programme and share the results with the DOE

Some amount of scheduled wastes is also expected during the construction and commissioning stages of the project, that include, amongst others, oil-contaminated wastes (i.e. spent oil/grease used for construction vehicles), spent organic solvents and paint sludge/residues. These scheduled wastes shall be temporarily stored within the site until such time when it is sent to Kualiti Alam's Scheduled Wastes Treatment Facility in Bukit Nenas or recycling facilities approved by the DOE.

Similarly, some amount of sewage related wastes is also expected during the construction and commissioning stage of the project that would be generated from the toilet facilities provided at the site offices and workers' accommodations. These facilities shall be constructed in accordance to the requirements of the SPAN, the Sewerage Services Department and IWK. These facilities should be desludged on a regular basis by Indah Water Konsortium (IWK) or its appointed contractors; and disposed at the nearest IWK Sludge Disposal Facility. **Table 9-8** below describes the procedures for monitoring waste generation and management during the construction phase.

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Table 9-8: Monitoring of Waste generation and Management during Construction Phase

| Issue | Procedures |
|------------------------------|---|
| Waste management programme | The Project Proponent will prepare a waste management programme, that includes efforts towards recycling and reuse efforts, in order to reduce impacts associated with the generation and disposal of wastes from the project sites. Concurrence from the relevant authorities shall be sought prior to the submission of the programme to DOE and Local Authority for approval. |
| Submission and Documentation | <p>The Project Proponent to submit waste management programmes for permanent and temporary construction works. The Contractor to implement the construction activities according to plan.</p> <p>The Project Proponent shall submit plans for the construction of temporary and permanent sewage and effluent treatment plants to ensure the sewage and industrial effluent are treated to the approved standards prior to discharge (including relevant forms). The status of compliance to the Conditions of Approval of the EIA shall be submitted to DOE on a quarterly basis (including relevant forms).</p> <p>The Project Proponent shall keep accurate and up-to-date records of the scheduled wastes generated from the project and to submit these records to the DOE within 14 days at the end of every period of three (3) months to the DOE. The Contractor shall provide proper labelling, containers and storage areas as well as prohibition of storage of incompatible waste as stipulated by DOE.</p> |

9.4.4.6 Wildlife Management Plan

A Wildlife Management Plan is intended mainly to solve the issues related to the predicted impacts on the wildlife, primarily medium and large mammals including primates. This framework is designed to mitigate the issues (predicted impacts) to minimise the impacts of the Project on wildlife.

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Wildlife Management Plan During Pre-Construction Phase

Although it was predicted that the impact of the Project will be minimal on wildlife and no mitigation measure was proposed, to ensure the safety of the wildlife, and wildlife-human conflict, several activities will be required to be done at this stage.

(a) Rapid Wildlife Survey

The objective of this rapid survey is to monitor the presence endangered wildlife species. It was suggested in Chapter 8 that banteng (*Bos javanus*) needs to be translocated if they (5 individuals estimated in the EIA study) are still living in the Bukit Bindu Forest Reserve. This rapid survey also will provide insight to the presence of other endangered wildlife species. Translocation may be required to ensure the safety of these individuals.

To note, the Department of Wildlife and National Parks (PERHILITAN) is the only local authority responsible for the translocation process including trapping and catching, transporting and releasing the animals at the selected release site.

Wildlife Management Plan During Construction Phase

There are several major activities that will be carried out during this stage which include land clearing and earthworks for construction of temporary access road, constructions of road embankment, and construction of railway. As indicated in **Chapter 7**, the activities during this stage will cause i) disturbance to wildlife, ii) disorientation, iii) displacement due to habitat loss and iv) some may be perish.

(a) Wildlife Education

To enhance and ensure the wildlife management plan is much more effective, other on site actions should be implemented by the proponents;

- i) All environmental officers and workers at the construction site should be educated on the important of conservation and laws on wildlife and forestry.

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- ii) Apart from education program pamphlets and leaflets will be posted at the camp or work areas.
- iii) After completion, all construction materials should be removed because all of these materials can be used as hiding places by wildlife, including reptiles (e.g. snakes). Venomous snakes such as cobra can pose a threat to human.

(b) Wildlife Monitoring

At this stage, wildlife monitoring is needed to gather information on the species and location of wildlife along the HSR alignment especially segment within forest areas (Bukit Bindu Forest Reserve). Monitoring at this stage can be made in two ways;

- i) Monitoring from reports received from locals and workers on wildlife found at the Project site.
- ii) Survey is another way of monitoring the presence of large mammals. This is a brief survey that can be conducted by PERHILITAN at the construction areas within the forest areas.

Evaluation can be made based on these reports on the safety of the wildlife and surrounding local communities.

(c) Monitoring for Wildlife Encroachment or Conflict

The encroachment or conflict means here is the wildlife that lives outside its normal habitat such as plantations and human habitations. Wildlife living outside its normal habitat may or may not cause problem. Once this species causing problem to human, it is considered as a conflict between wildlife and human.

Assessment can be done by compiling all the conflicts occurring along the alignment (if available). These data can be gathered from the complaint or conflict reports available at the PERHILITAN (Peninsular Malaysia or Selangor/Kuala Lumpur/Negeri Sembilan/Melaka/Johor Office). This assessment should be carried out by the PERHILITAN or other consultants.

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The need for monitoring of wildlife and its requirements is subject to the requirement and/or approval by the Department of Wildlife and National Parks Peninsular Malaysia.

9.5 ENVIRONMENTAL MANAGEMENT PROGRAMME – OPERATIONAL PHASE

9.5.1 Introduction

The EIA Consultant recommends that a Code of Practice for Environmental Management should also be drawn up to cover the operational activities of the Project. The Code of Practice for the project operations will set out environmental performance guidelines, standards and required environmental monitoring and management practices that are to be complied with. Here again, the aim would be to ensure that the inevitable environmental effects associated with Project operations are recorded, analysed, properly managed, and a satisfactory level of environmental protection is achieved.

Standards to be complied to be based on the environmental monitoring and management programmes that were carried out within the Project areas during the construction phase. The Project Proponent should then discuss these standards with the appropriate authorities and Government departments before finalizing and adopting the environmental monitoring and management programme during the operational phase.

9.5.2 General Requirements

The Project Proponent and its operators shall be required to adhere to all the requirements of the code, and should be responsible for ensuring that all third party, out sourced, contractors (i.e. operations and maintenance contractors) involved in Project operations do likewise. The Project Proponent shall be required to comply with all legal duties and obligations regarding the protection of the environment (e.g. those laid down in the Environmental Quality Act 1974, any further relevant legislation introduced prior to the commissioning of the plant, and all regulations, standards and guidelines made under the

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authority of such legislation). Where there is an apparent conflict between these standards, the more stringent standard should be adopted.

The Company appointed by the Project Proponent to undertake the HSR operations should consider adopting the following EMP and liaise with the State DOE Officers to finalize the EMP structure and scope. The appointed Company shall be required to submit to DOE, a detailed environmental management plan for the operational phase that outlines all the operational activities which will be carried out, the character and duration of those activities, the measures proposed to minimize any resulting environmental impacts as well as the environmental monitoring programme to gauge actual real time impacts induced. The appointed Company will be responsible for consulting the Local Authorities, relevant Agencies and the DOE in drawing up the environmental management plan. The appointed Company should be required to obtain DOE's acceptance of the detailed environmental management plan prior to the operations phase. The environmental compliance responsibility during the operational phase lies solely with the appointed Company who is expected to delegate such duties to the appointed Environmental Manager and its operators.

9.5.3 Operational Activities

The potential environmental impacts arising from the operational activities of the HSR Project relate mainly to noise, vibration, air quality, water quality, road traffic near to Stations, and waste management and disposal. Water quality impacts arising from the Project is expected to be minimal, unless recurring soil erosion and sedimentation effects at cleared (worked over) areas during the construction phase occur. Nevertheless, a programme for the monitoring of water quality impacts shall be integrated into the overall monitoring programme carried out for the Project.

9.5.4 Environmental Monitoring During Operational Phase

9.5.4.1 Air Quality

Environmental impacts associated with emissions of air pollutants from operational activities of the Project are expected to be insignificant. However, it is expected that with the operation

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of the HSR service, a reduction in the ambient levels of CO, CO₂, NO_x is expected to occur as a consequence in reduction of road traffic and air travel. It would be impractical to measure the reduction in carbon dioxide emissions over time.

However the air quality around the Stations and Maintenance Depots should be periodically be monitored and the impacts on neighboring residential areas assessed.

At this juncture, it should be noted that the Malaysian Government has established formal standards for air quality. The recommended standards for stipulated parameters as summarised in **Table 9-9** below should be adopted.

Table 9-9: Monitoring of Air Quality during Operational Phase

| Issue | Standards and Procedures |
|----------------------------------|--|
| Air quality monitoring programme | <p>The Project Proponent to submit programme for air quality monitoring to the DOE before the commencement of the operational phase. Details to be submitted will include locations of the air quality monitoring, frequency of sampling, equipment used (dust deposition gauges, air samplers) and routing of monitoring results.</p> <p>The air quality parameters to be monitored are only those relevant to the operations of stations and depots. The frequency of monitoring should be at least once in six (6) months and the report submitted to DOE twice a year. The proposed monitoring points are shown in Appendix 9A.</p> |
| Submission and Documentation | <p>The Project Proponent to submit to the DOE the results of the monitoring programme once every six (6) months. The Project Proponent should continue to submit the compliance report (on the Conditions of Approval of the EIA) and relevant forms once every three (3) months until such time instructed otherwise by the DOE.</p> |

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Proposed Parameters to be Monitored

- (i) Total Suspended Particles (TSP)
- (ii) Nitrogen Dioxide (NO₂)
- (iii) Carbon Monoxide (CO)
- (iv) PM₁₀

The ambient air quality and emission limit requirements to be complied for the Project are identified and listed in **Chapter 6**.

Proposed Frequency of Monitoring

It is the recommendation of the EIA Consultant that, for the ambient air quality monitoring, all the parameters listed above shall be monitored once every six (6) months.

Proposed Location of Sampling Stations

At selected points located adjacent to the Stations and Maintenance Depots. The locations of the proposed ambient air monitoring points are given in **Appendix 9A**. Notwithstanding the above, the Project Proponent shall ensure that the selected parameters, frequency of monitoring and the location of sampling sites associated with the monitoring exercise are approved by DOE prior to the commencement of the air monitoring exercise.

9.5.4.2 Noise and Vibration

Monitoring of environmental noise and vibration levels in the vicinity of the Project facilities will be required to be carried out mainly to document the extent and magnitude of noise and vibration induced from train operations and from stations and maintenance depots. The monitoring of L₁₀, L₉₀ and L_{eq} noise levels, and peak particle velocities associated with vibration transmissions, in these areas will assist the Project Proponent in ensuring that noise and vibration emitted from the track and stations does not exceed acceptable levels, [i.e. 65 dB(A) and 3 mm/sec]. The ambient noise and vibration level criteria to be complied for the Project are identified and listed in **Chapter 6 (Section 6.11.3)**. In respect of vibration monitoring requirements, periodic three dimensional vibration levels shall be monitored near

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to buildings that are located close to the track, especially sensitive dwellings such as schools, clinics, hospitals, religious establishments and commercial buildings using sensitive equipment. These measurements shall also serve to demonstrate whether the Project is causing any nuisance effects on adjacent commercial and housing schemes.

Operational induced noise levels shall be compared with baseline levels. Noise surveys should be conducted alongside the track. This survey shall concentrate on identifying source of noise emissions to ensure appropriate noise abatement technology has been applied. The environmental noise surveys should be repeated at periodic intervals, or when complaints are recorded from the public. **Table 9-10** below describes the procedures for monitoring noise and vibration levels during the operational phase.

Table 9-10: Monitoring of Noise and Vibration Levels during Operational Phase

| Issue | Procedures |
|--|---|
| Noise and vibration level monitoring programme | The Project Proponent to submit programme for noise and vibration level monitoring to the DOE before the commencement of Project operations. Details to be submitted will include locations of the noise and vibration level monitoring stations, frequency of monitoring, equipment to be used and information dissemination related to the monitoring results. The parameters to be monitored should include others monitored during the tenure of the EIA study. The frequency of monitoring should be at least once every six (6) months and the report submitted to DOE once every six (6) months. The proposed monitoring points are shown in Appendix 9B2 . |
| Submission and Documentation | The Project Proponent to submit to the DOE the results of the monitoring programme once every six (6) months. The Project Proponent should continue to submit the compliance report (on the Conditions of Approval of the EIA) and relevant forms once every three (3) months until such time instructed otherwise by the DOE. |

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Proposed Parameters to be Monitored

Proposed parameters to be monitored are L_{\max} , L_{10} , L_{50} , L_{90} , L_{eq} , and mm/s for vibration.

The ambient noise and vibration limits to be complied for this project are identified and listed in **Chapter 6** respectively.

Proposed Location of Sampling Stations

The locations of the proposed noise and vibration monitoring points are given in **Appendix 9B2**. Notwithstanding the above, the Project Proponent shall ensure that the selected parameters, frequency of monitoring and the location of sampling site are approved by DOE State prior to the commencement of the noise monitoring exercise.

Proposed Frequency of Monitoring

Proposed frequency of monitoring is once every six (6) months.

It is recommended by the EIA Consultant that the frequency of noise and vibration monitoring be at least once every three (3) months during the commissioning stage of the Project. This is to enable the Project Proponent to monitor the performance of the equipment and machinery more closely and carry out any engineering controls (in cases of non-conformance) to ensure compliance to the ambient noise and vibration standard criteria. It is also proposed that sampling locations near to adjacent dwelling units be retained for monitoring during the commissioning stage.

The Project Proponent shall carry out a comprehensive Dilapidation study during the operational phase (on a periodic basis) for structures located 50 m from the railway tracks to ascertain the scope of mitigation and control measures required to be implemented in order to protect the integrity of adjacent structures out of vibration events.

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9.5.4.3 Water Quality

Anthropogenic activities associated with the Project development and operations are one of the sources of water pollution. However, the Project is expected to pollute the receiving waters only when the wastewater treatment facilities for domestic and industrial waste are inadequate to cope with the load or because of malfunction of its equipment during its operation. Efficient operations of wastewater treatment systems will assist in reducing pollutants from entering the watercourse (especially the rolling station wash water treatment plant). **Table 9-11** below describes the procedures for monitoring of terrestrial waster quality during the operational phase.

Table 9-11: Monitoring of Terrestrial Water Quality during Operational Phase

| Issue | Procedures |
|------------------------------------|---|
| Water quality monitoring programme | <p>The Project Proponent to submit a programme for monitoring surface drainage and river water qualities before the commencement of any HSR operations. Details to be submitted will include locations of the monitoring stations, frequency of monitoring, equipment to be used and routing of the monitoring results.</p> <p>The parameters to be monitored should include those monitored during the tenure of the EIA study. The frequency of monitoring should be at least once every six (6) months and the report submitted to DOE once every six (6) months. The proposed monitoring points are given in Appendix 9C2.</p> |
| Submission and Documentation | <p>The Project Proponent to submit to the DOE the results of the monitoring programme once every six (6) months. The Project Proponent should continue to submit the compliance report (on the Conditions of Approval of the EIA) and relevant forms once every three (3) months until such time instructed otherwise by the DOE.</p> |

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Proposed Parameters to be Monitored

Discharge of STPs at stations, depots, heavy Maintenance Base and Light maintenance Bases - pH, TSS, DO, BOD₅, COD, Oil & Grease, E.Coli and NH₃N.

Proposed Location of Sampling Stations

The locations of the proposed water monitoring points are given in **Appendix 9C2**. Notwithstanding the above, the Project Proponent shall ensure that the selected parameters, frequency of monitoring and the location of sampling sites are approved by DOE prior to the commencement of the water monitoring exercise.

Proposed Frequency of Monitoring

Proposed frequency of monitoring is once every six (6) months.

9.5.4.4 Waste Generation and Management

The collection and disposal of the solid wastes from the Project are anticipated to be carried out by private contractors; as is the current practice. The Project Proponent will have to ensure the collection and disposal is regular and carried out in a sanitary manner.

9.5.4.5 Wildlife Management

The HSR Project shall be fenced along the at-grade area as to avoid any potential crossing. Thus, it is anticipated there shall be no potential incident of wildlife crossing within the HSR alignment.

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9.6 PERFORMANCE MONITORING

The targets for this scope of monitoring would include plant, machinery and equipment that are employed to either construct or operate the HSR components.

During the **construction phase** the performance of construction machinery, such as cranes, trucks, soil augers, piling machines, bulldozers, etc. need to be monitored with respect to noise emissions. The list of typical construction machinery equipment and their expected baseline noise and vibration levels are summarized in **Tables 9-12** and **9-13**. Periodic monitoring of these noise levels should be carried out to ensure that they are in optimum operational mode and will therefore not exert adverse background ambient noise levels in surrounding areas. The Project Proponent, through the Environmental Manager, should require all contractors to submit evidence that all machinery and equipment in use comply with the guideline noise levels. The Project Proponent should also use its own resources to carry out spot checks on monitoring noise levels of plant and machinery in use at construction sites.

Table 9.12: Typical Construction Equipment Noise Emission Levels

| Equipment | Typical Noise Level (dBA) 50 feet (~15 m) from Source |
|-------------------|--|
| Air Compressor | 81 |
| Backhoe | 80 |
| Ballast Equalizer | 82 |
| Ballast Tamper | 83 |
| Compactor | 82 |
| Concrete Mixer | 85 |
| Concrete Pump | 82 |
| Concrete Vibrator | 76 |
| Crane, Derrick | 88 |
| Crane, Mobile | 83 |
| Dozer | 85 |
| Generator | 81 |
| Grader | 85 |
| Impact Wrench | 85 |

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| Equipment | Typical Noise Level (dBA) 50 feet (~15 m) from Source |
|----------------------|--|
| Jack Hammer | 88 |
| Loader | 85 |
| Paver | 89 |
| Pile-driver (Impact) | 101 |
| Pile-driver (Sonic) | 96 |
| Pneumatic Tool | 85 |
| Pump | 76 |
| Rail Saw | 90 |
| Rock Drill | 98 |
| Roller | 74 |
| Saw | 76 |
| Scarifier | 83 |
| Scraper | 89 |
| Shovel | 82 |
| Spike Driver | 77 |
| Tie Cutter | 84 |
| Tie Handler | 80 |
| Tie Inserter | 85 |
| Truck | 88 |

Source: Transit Noise & Vibration Impact Assessment. Office of Planning and Environment, Federal Transit Administration, United States of America Department of Transportation, May 2006.

Table 9-13: Vibration Source Levels for Construction Equipment

| Equipment | | PPV at 25 feet (~8 m) | |
|--------------------------------|-------------|-----------------------|-------|
| | | in/s | mm/s |
| Pile Driver (impact) | upper range | 1.518 | 38.6 |
| | typical | 0.644 | 16.4 |
| Pile Driver (sonic) | upper range | 0.734 | 18.6 |
| | typical | 0.170 | 4.32 |
| Clam shovel drop (slurry wall) | | 0.202 | 5.13 |
| Hydromill (slurry wall) | in soil | 0.008 | 0.203 |
| | in rock | 0.017 | 0.432 |

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| | | PPV at 25 feet (~8 m) | |
|------------------|--|-----------------------|--------|
| Vibratory Roller | | 0.210 | 5.33 |
| Hoe Ram | | 0.089 | 2.26 |
| Large bulldozer | | 0.089 | 2.26 |
| Caisson drilling | | 0.089 | 2.26 |
| Loaded trucks | | 0.076 | 1.93 |
| Jackhammer | | 0.035 | 0.889 |
| Small bulldozer | | 0.003 | 0.0762 |

Source: Transit Noise & Vibration Impact Assessment. Office of Planning and Environment, Federal Transit Administration, United States of America Department of Transportation, May 2006.

In addition the treatment performance of temporary sanitary systems should be periodically monitored for its efficacy in meeting specified pollutant discharge set standards. Similarly the efficacy of silt traps need to be monitored regularly by the contractor and report on results submitted to the Project Proponent. The contractor shall recommend remedial measures if the silt traps are not functioning to design intent

During the **operational phase**, the emphasis shall be placed on monitoring the efficacy of sewage and wastewater treatment plants established at stations and maintenance depots. Furthermore HSR train equipment capable of emitting noise, such as compressors, air conditioning units etc shall be monitored periodically for their compliance to standard noise ratings. This would also apply to plant and equipment installed at stations and at maintenance depots.

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9.7 ENVIRONMENTAL AUDITS

The third-party environmental audit shall be carried out throughout the Project period. The main objectives of the environmental audit are to determine whether there are any non-compliances to the environmental requirements as stated in the EIA and EMP as well as to ensure that all the P2M2s are properly implemented, functioning as per designed and adequately maintained to ensure its performance.

The appointed third-party auditor shall be registered with DOE, whom is Certified Erosion, Sediment and Storm Water Inspector (CESSWI) or with equivalent qualification. The environmental audit shall be carried out in accordance to the Environmental Audit Guidance Manual published by DOE Malaysia.

The site audit will be carried out in accordance to the accepted protocol detailing areas of non-compliance. Any non-compliance with legislative standards will be identified and probable cause of such non-compliances investigated.

CHAPTER 10

CONCLUDING REMARKS

10.1 STUDY FINDINGS

10.1.1 Introduction

The EIA study that has been carried out for the HSR Project has focused on assessing and evaluating the scope and extent of residual environmental perturbations that can materialize during the HSR Project's construction and operational phases, taking due cognizance of the planning efforts aimed at reducing adverse environmental impacts to tolerable levels. The EIA study also placed emphasis on determining whether additional mitigation and amelioration measures are required in order for the HSR Project to comply consistently with air, water and noise and vibration ambient standards and regulations, and the need to further reduce nuisance conditions that could possibly be imposed on communities.

It has been verified that this HSR Project will adopt the latest innovative HSR technologies in order to minimize energy demands, to enhance service safety standards and to ensure commuters a comfortable, convenient, reliable, punctual and affordable service. A main focus of the HSR Project is to entice commuters to migrate from car, bus and air travel to the HSR service, and to achieve high occupancy rates over time (at least 80 %), in order that a net positive life cycle environmental impact is attained.

Currently, preliminary designs of the HSR Project's components are on-going as a pre-requisite to develop suitable information to solicit Tenders from a qualified Project Delivery Partner (PDP) to implement the HSR Project.

10.1.2 Impact Assessment Findings

The major environmental impacts of concern associated with the development and operations of this Project include air, water and noise and vibration impacts. In addition aesthetics, safety, soil erosion and sedimentation and risk issues can also assume center stage. A summary of the potential environmental impacts that can materialize during the HSR Project's construction and operation phases were investigated and the consequential environmental perturbations that could materialize are documented as described herewith.

Construction Phase

It has been ascertained that during the HSR Project's construction phase, there could be possibilities for residential areas located close to the construction sites (30 to 50 m) to be subjected to adverse air and noise, and potentially vibration impacts, albeit on a short term basis. However there are well established control measures that have proven to be able to ameliorate adverse impacts to tolerable levels and the potential adverse noise and air quality impacts can be curtailed to acceptable levels through adoption of both structural, non structural and by proper administration/management measures

The HSR Project's earthworks and biomass disposal operations will be extensive (estimates of 1,111,403 m³ of soil and 139,306 tons of biomass requiring transport and disposal along the approximate 328 km HSR alignment). Pathways used for transporting soils and biomass should not be located within 300 m of residential areas.

Soil erosion incidences will be of concern especially during monsoon seasons and when cleared areas are located upstream of public water supply treatment plants and intakes, and if the hydraulic capacity of receiving water courses are low. On the whole, the resulting water quality impacts and potential flooding episodes can be moderated to acceptable levels based on adoption of effective management practices over clearing and re-vegetation operations, proper placement and maintenance of silt traps, and timing of works. In any case the duration of the construction period is relatively of short term and impacts will be intermittent over this tenure.

The amount of sewage and industrial wastewater discharges from the seven (7) HSR Stations and three (3) maintenance depots will be moderate to low. However, the Project Proponent is committed to ensure that the latest innovative treatment facilities are adopted to reduce residual pollutants levels that will not undermine the receiving water courses existing water quality status nor its resource capability.

The HSR Project is expected to positively contribute towards the development of the national economy by compressing geographical distances and rebalancing economic growth by spreading development to the southern region. More directly, it will also have an impact on the economy through construction activities and subsequent commercial / economic activities associated with an improved transportation network. Based on the assessment of

the Economic Evaluation of Environmental Impacts (EVEI), after discounting at the rate of 4 %, the total present value of the stream of net loss in environmental services amounts to - RM6.118 million over a 50-year period. The present value is very small because the economic value of the reduction in environmental services from the loss of forest, oil palm and rubber land is almost fully compensated by the economic value of the reduction in CO₂ emission due to modal shift.

The construction of the HSR alignment over Tebrau Strait will not have any adverse impacts on the water quality and ecological status of this water body; nor will it hamper vessel navigations along the Straits.

Potential adverse impacts on terrestrial ecosystems, and on community public health status along the construction sites, can be effectively controlled to tolerable levels employing well known mitigation measures.

However adverse long term social impacts could materialize with the eviction and relocation of people and businesses and the acquisition and fragmentation of private lots. A Social Impact Assessment Study (SIA) is being carried out by the Project Proponent to address these potential adverse impacts as well as the potential benefit impacts.

Operational Phase

It is predicted that during the HSR Project's operational phase, net positive impacts will materialize, but subject to predictions of commuter cross over to the HSR service becoming a reality. The major positive impacts that can occur include the substantial net reduction in yearly transportation related greenhouse gas emissions. Carbon dioxide (CO₂) is the only greenhouse gas of concern and based on the assessment, the HSR Project would reduce 435,590 tons of CO₂ per year. Another positive impact would be the potential reduction in road accidents and community health issues that can materialize, in comparison with the business as usual scenario where the HSR Project is not implemented.

The HSR Project will create about 111,000 jobs opportunities during planning, construction and operation. The HSR Project is also expected to boost local economy following the potential investments from companies. It creates a spill over effect to the local people with a high demand of manpower to support the services.

The HSR Project will enhance the productivity through connectivity. The Greater Kuala Lumpur / Klang Valley (Greater KL / KV) urban conurbation of 7.2 million people and Singapore with 5.4 million people are both major population and economic centres in Southeast Asia. The intermediate cities served by the HSR Project range in size from around 250,000 people in Muar (the smallest city served) to 1.1 million people in the greater Seremban area.

The main value proposition of the HSR Project is that it offers significant travel time savings over traditional modes of transport. The HSR Project shall trim travel time between KL-Singapore to a minimum of 90 minutes, compared with 4–5 hours by road, 7 hours by conventional rail services, or 3 hours by air.

Noise, vibration, air and water quality adverse impacts can be adequately mitigated adopting well tried and tested methodologies and by introducing stringent and exhaustive surveillance measures.

It is important that adequate facilities and mitigation measures be implemented to prevent animal and people collisions, to avoid impeding cross flow traffic, and surface flows, across the HSR alignment especially when it is constructed as an At-Grade alignment.

10.2 SURVEILLANCE AND MONITORING PROGRAMS

It is important for exhaustive surveillance and monitoring programs to be evolved and implemented in order to confirm whether predicted environmental impacts induced by the construction and operations of the HSR Project are accurate and realistic, and whether all required mitigation and abatement measures have been implemented and are functioning adequately. Such measurements provide the Project Proponent an opportunity to take effective remedial measures if residual impacts exceed regulatory or guideline control values. In this respect, Chapter 9 of this EIA report details in depth the scope and range of monitoring and performance measurements that are required to be taken during the Project's construction and operational phases, together with the locations where the measurements are to be taken, as well as the pollutant parameters to be measured at what range of frequencies. In addition the manpower needs, range of instruments and manpower organizational structure required to execute the monitoring programme are also detailed.

An audit of the environmental performance of the construction phase is required to be executed in order to gauge the overall effectiveness of mitigation and control measures introduced, and the extent of residual impacts induced on human and ecological habitats and the consequences that materialized.

10.3 CONCLUDING REMARKS

It is concluded that from an environmental perspective that the chosen HSR alignment is not expected to induce environmental perturbations of note that can materially affect the health, and safety of community's resident within areas surrounding the HSR Project's alignment; and in addition will not have any significant impacts on ecological and surface and ground water regimes.

The HSR Project is expected to induce positive long term environmental impacts through its capability to reduce net emissions of greenhouse gases by the transportation sector in Malaysia, enhancing connectivity, increase connectivity through time saving, creating job opportunities and reducing traffic accidents by implementing HSR Project.

MyHSR Corp is committed to implement all the P2M2 identified in this report and to ensure they are implemented effectively throughout the construction and operational process. MyHSR is also committed to mainstreaming environmental protection into the Project and towards self-regulation to ensure that the quality of the environment is protected during the construction and operation of HSR Project.